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Nutritional and grain quality characters correlation with yield components in different conventional land races and improved varieties for *in situ* conservation in Tamil Nadu in rice (*Oryza sativa* L.)

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The aim of present research was to assess physicochemical and grain qualities of traditional land races and rice cultivars native to temperate region (Tamil Nadu) of India. Traditional varieties in India and across the Asia serious threat of extension because of arrival of high yielding varieties, hybrids, genetically engineered rice came for nowadays to increase the malnutrition and different human disease is the major problem. Trial material comprised of ten parents which comprised in six cultivars of female parents and four conventional landraces utilized as male parents, F_1, F_2 and F_3 generation of six crosses. Parents and two crosses *viz.*, IR 72 x Veeradangan, ADT 39 x Kavuni were chosen F_3 generation dependent on the biometrical characters present in quality and nutritional traits in grains. These desirable characteristics (nutritional, grain quality) exploit farmers to preserve these traditional and improved cultivars encourage farmers to cultivate.

Keywords: Cultivated varieties, Grain quality, Land races, Nutritional traits, Rice, Segregating generations

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Rice is an important food for most of the people, giving around 80% in every day energy intake[9]. Carbohydrates, unsaturated fats and nutrients (vitamins, minerals) are the significant supplement segments in rice. It is financially significant sustenance crop with nourishing broadening and helps destitution easing. In India, more than 60% of small children get lacking energy regularly to equate the development and requirements[11].

Brown rice is one kind of the well-known energetic items because of it is wealthy in supplement and bioactive components.

The examination on the impact of cooking methods on a few perspectives occurring at rice would benefit the customers to deliver high quality of cooked rice and would also benefit to consumers to set up the higher nourishing and eating quality of rice. The cooking and eating value is determined by the amylose content for good cooking and gelatinization temperature for grain dissolvent. The cooking attributes of crop is the base of decision for the consumers. The amylose content is great determinant of rice cooking and eating characteristics[16]. The two crosses which registered higher mean values for more than one trait offers more scope for selecting superior segregants in the respective progenies[5]. The difference in these parameters can be exploited by the rice breeders in their hybridization programme. The better quality rice is also delighted by the consumers for preference.

Materials and methods

The present study utilized the experimental material comprising of five generations including, P_1, P_2, F_1, F_2 and F_3. The material comprised of four male parents used in medicinal therapeutic landraces, viz., Veeradangan, Kavuni, Kathanellu and Navara which were gathered from Tamil Nadu and Navara is a therapeutic reported in Kerala these landraces rice varieties are having prevalent nutritional present abundant in grain qualities and inferior characters in yielder and six female parents in improved semi-dwarf high yielding varieties *viz.*, IR 72, ADT 39, ADT 45, ASD 16 ,TPS 4 and check ADT 43 by receiving a spacing of adopted in 30 x 10 cm at TNAU, Madurai, was completed during 2012 to 2014 (Fig. 1). Grain quality characters, amylose content and nutritional characters *viz.*, calcium, magnesium, iron and zinc were recorded in parents and 20 plants chose in F_3 sergeants of two cross combination.

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Biometrical characters were replicated multiple occasions for individual cultivars, therapeutic land race and hybrids of the crosses combinations. For interpretation statistical procedures were included for the analysis and conclusion. Significant simple coefficients correlated between various grain, nutritional traits and single plant yield. Simple correlation was resolved utilizing the technique used for analysis by [4].

Nutritional characters

All the ten parents and two F_3 populations (20 plants) were chosen dependent upon single plant in grain colour and yield for biochemical analysis. After harvest the grain samples were dried and maintained moisture content upto 12-14%. Removal of Bran for Hulling was completed by Palm dehusker parts which were comprised material of plastic and wooden to provide the strength. Three imitate were accomplished for all the nutritional characters, viz., calcium, magnesium, iron and zinc contents.

Digestion for mineral and micronutrient analysis

Approximately 2 g of grained grain powder was taken in a small size flask with cover contains 12 mL of triple acid mixture (9:2:1 Nitric: Sulphuric: Perchloric acid) was poured to the sample and kept for heat digestion and cold assimilation in night. The processed grained powders were kept on a burning plate still digested liquid changed from brown to colourless. Concentrate was added sterilized heated water and diluted to approximately in 100 mL and utilized for estimation of major minerals, viz., calcium, magnesium and micronutrients to be specific iron and zinc.

Fig. 1 — Seed Coat, Dehusked rice variation of land races in rice

Results and discussion

The mean values parents demonstrated extensive variety for all charactistics under study revealing extent of improvement of grain quality, nutritional traits and single plant yield. The chosen F_3 plants contains individually (20 plants) in IR 72 x Veeradangan and ADT 39 x Kavuni with their selected parents mean performance was presented in Table 1 & Table 2

IR 72 x Veeradangan

Among the 20 single plants studied, plant 10 showed significant mean value for eight characters for five grain quality and three nutritional characters, plant 6 for six grain quality and two nutritional characters and plant 16 for eight grain quality characters (Fig 2). Plant 3, 11, 18 and 9 had

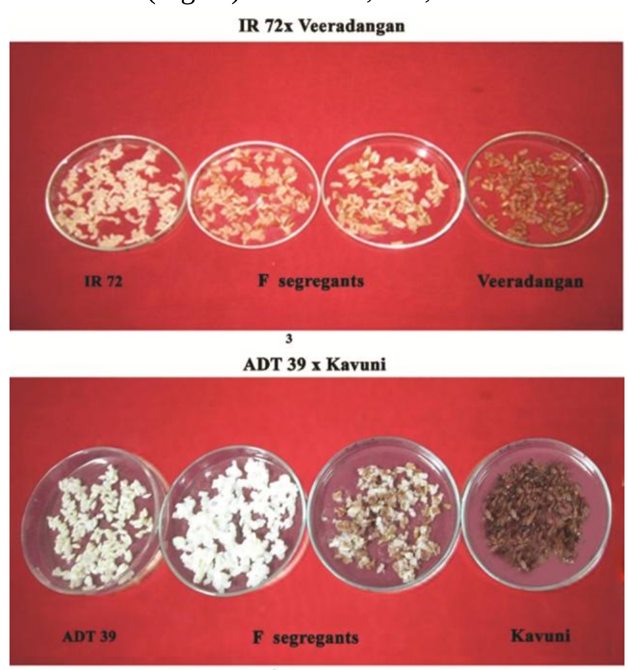

Fig. 2 — Grain colour variation

Selected F3 plants of the cross (IR 72 x Veeradangan) for grain quality traits in rice

Selected F3 plants of the corss (ADT 39 x Kavuni) for quality traits in rice

Table 1 — Mean performance of selected F_3 plants of the cross (IR 72 x Veeradangan) for grain quality and nutritional traits

Genotypes	KL (mm)	KB (mm)	KLBR	KLAC (mm)	KBAC (mm)	LER (mm)	BWER (mm)	ASV	AC (%)	Ca (mg/ 100 g)	Mg (mg/ 100 g)	Fe (mg/ 100 g)	Zn (mg/ 100 g)	SPY (g)
Parent 1	6.63*	2.07	3.20*	8.90*	2.53	1.35*	1.22*	3.66	20.44	6.46	68.30	0.67	1.33	35.30
Parent 2	5.53	2.61*	2.11	6.73	2.94*	1.21	1.12	2.00*	25.15*	8.29*	120.63*	1.61	2.92*	39.62
Selected F_3 plants														
Plant 1	5.69	2.23	2.55	6.74	2.63	1.18	1.18*	4.00	19.26	7.03*	92.73*	0.78	1.93*	37.60
Plant 2	5.64	2.25	2.50	6.86	2.64	1.21	1.17*	2.00*	23.39*	6.37	97.63*	0.73	1.53	38.76
Plant 3	6.14*	2.35*	2.61	7.14	2.77*	1.16	1.18*	3.00	24.39*	5.39	84.58*	1.03*	1.53	42.48
Plant 4	6.16*	2.38*	2.59	7.41	2.75*	1.20	1.15	3.00	23.46*	6.61	94.80*	0.72	1.98*	41.37
Plant 5	5.75	2.27	2.53	7.83*	2.60	1.30*	1.14	3.00	23.04*	6.75	86.42*	0.84*	1.63	41.18
Plant 6	6.24*	2.34*	2.66*	8.24*	2.72*	1.32*	1.16	3.00	19.25	6.05	74.63	0.85*	1.96*	36.29
Plant 7	5.39	2.41*	2.23	6.64	2.82*	1.23	1.17*	3.00	22.21	6.14	83.49*	0.83*	1.77	38.00
Plant 8	5.71	2.31*	2.47	6.78	2.73*	1.19	1.18*	4.00	20.87	7.39*	64.33	0.94*	1.95*	32.30
Plant 9	5.96	2.31*	2.58	7.83*	2.60	1.31*	1.12	2.00*	21.85	6.79*	71.40	0.86*	1.86*	31.94
Plant 10	6.34*	2.33*	2.72*	7.59*	2.64	1.20	1.13	4.00	23.01*	7.65*	93.59*	0.56	1.96*	42.64
Plant 11	6.35*	2.38*	2.67*	7.69*	2.67	1.21	1.12	3.00	23.41*	6.80*	62.88	0.65	1.88*	41.60
Plant 12	5.93	2.23	2.66*	7.28	2.64	1.23	1.18*	4.00	23.24*	6.40	71.85	0.53	1.56	28.67
Plant 13	6.06*	2.21	2.74*	7.34	2.62	1.21	1.18*	4.00	22.16	7.18*	73.18	0.84*	1.72	29.02
Plant 14	5.69	2.23	2.55	6.68	2.64	1.17	1.18*	2.00*	22.71	6.23	81.89*	0.70	1.82	39.09
Plant 15	6.40*	2.34*	2.73*	8.40*	2.67	1.31*	1.14	3.66	22.79	6.18	81.68*	0.62	1.51	32.40
Plant 16	6.54*	2.41*	2.71*	8.20*	2.86*	1.25*	1.19*	3.00	23.09*	6.12	61.43	0.73	1.74	36.09
Plant 17	5.84	2.38*	2.45	7.76*	2.63	1.32*	1.10	3.00	22.33	6.43	82.66*	0.85*	1.96*	41.80
Plant 18	6.53*	2.23	2.92*	8.38*	2.60	1.28*	1.16	2.00*	18.47	6.13	91.69*	0.91*	1.62	39.56
Plant 19	5.62	2.22	2.52	7.78*	2.70	1.38*	1.21*	4.00	18.45	7.39*	73.29	0.74	1.83	34.26
Plant 20	5.73	2.26	2.52	6.93	2.67	1.21	1.17*	2.33*	23.00*	6.38	61.58	0.63	1.93*	39.22
Grand mean	5.99	2.30	2.60	7.51	2.68	1.25	1.16	3.07	22.09	6.64	80.67	0.80	1.82	37.23
SE	0.021	0.007	0.02	0.014	0.021	0.007	0.007	0.113	0.219	0.077	0.169	0.014	0.014	-
CD (5 %)	0.07	0.02	0.04	0.16	0.06	0.03	0.02	0.34	0.63	0.22	0.49	0.03	0.05	-

significant mean value for four grain quality and three nutritional characters. Plant 4 for four grain quality and two nutritional characters, plant 8 for three grain quality and three nutritional characters, plant 15 for five grain quality and one nutritional character. The comparatively highest was showed in plant 15 and least by 10 had essentially significant in more in kernel length after cooking. The Veeradangan (2.94 mm) recorded altogether more in mean value for kernel breadth after cooking. Mean an incentive for twenty chose F_3 sergeants ranged from 1.16 to 1.38. Eight chose F_3 segregants recorded essentially more values comparatively high in grand mean (1.25). The IR 72 (1.22) showed huge breadth wise expansion proportion. Eleven F_3 segregants were observed in critical in breadth wise expansion ratio. The estimation of grand mean comparatively chose F_3 plants varied from upto 4.00. The significantly lesser alkali spreading value the dispersion of grains in plants selected F_3 *viz.*, 2, 9, 14, 18 and 20.

For amylose content Veeradangan (25.15) showed high cooking quality it have high in amylose content. Plant 3, 4, 11, 2, and 20 indicated significantly more in grand mean. While considering overall execution of chose F_3 population of IR 72 x Veeradangan, plant 10, 6, 3, 11, 18, 9, 4 and 8 its possessing more amount of quality with alluring supplement (calcium, magnesium, iron and zinc). Among the chose plants calcium content was high in plant 10 with a limit of 7.65 mg/ 100 g and magnesium content was high in single plant 4 (94.80 mg/100 g). Iron was high in plant 3 (1.03 mg/100 g) and zinc content were high in plant 4 (1.98 mg/100 g). Similar result were reported by[12, 2, 8.]

ADT 39 x Kavuni

For ADT39 x Kavuni blend, Plant 4 indicated noteworthy mean an incentive for six characters for five grain quality and one dietary character, plant 12 for four grain quality and two nourishing characters and plant 16 for four grain quality and two nutritional characters (Fig 2). Plant 6 for two grain quality and three nutritional characters, plant 15 for five grain quality, plant 18 for three grain quality and two

Table 2 — Mean performance of selected F_3 plants of the cross (ADT 39 x Kavuni) for quality and nutritional traits in rice

Genotypes	KL (mm)	KB (mm)	KLBR	KLAC (mm)	KBAC (mm)	LER (mm)	BWER (mm)	ASV	AC (%)	Ca (mg/ 100 g)	Mg (mg/ 100 g)	Fe (mg/ 100 g)	Zn (mg/ 100 g)	SPY (g)
Parent 1	6.23*	2.28	2.73*	8.60*	2.85*	1.38*	1.25*	3.00	20.13	6.29	61.54	0.54	1.62	32.05
Parent 2	5.14	2.35	2.18	6.34	2.67	1.23	1.13	2.00*	26.53*	12.29*	118.52*	1.35*	3.01*	32.86
Selected F_3 plants														
Plant 1	5.13	2.36	2.17	7.44*	2.70	1.45*	1.14	3.00	20.12	9.82*	78.22	0.75	1.86	34.51
Plant 2	5.23	2.26	2.31*	6.93	2.65	1.32	1.17*	3.00	21.13	7.87	67.76	0.93	1.73	32.14
Plant 3	5.16	2.24	2.30*	6.46	2.55	1.25	1.13	2.00*	20.30	9.45*	66.47	0.61	1.80	33.82
Plant 4	5.37*	2.23	2.40*	7.35*	2.73	1.37*	1.22*	2.66	22.61	8.37	76.71	0.85	2.16*	31.16
Plant 5	5.15	2.26	2.27	6.83	2.74	1.32	1.21*	2.33*	21.73	6.89	84.49*	1.25*	1.83	38.75
Plant 6	5.24	2.31	2.26	6.90	2.78*	1.31	1.19*	3.00	21.62	10.36*	74.47	1.05*	2.05*	32.27
Plant 7	5.21	2.33	2.23	7.81*	2.72	1.49*	1.16	3.00	20.92	8.76	87.70*	1.31*	1.76	21.34
Plant 8	5.20	2.20	2.36*	6.76	2.55	1.30	1.16	3.00	23.34*	8.21	88.70*	1.04*	1.83	28.74
Plant 9	5.17	2.45*	2.11	7.02	2.76*	1.35	1.12	3.00	23.98*	9.15*	53.38	0.64	1.84	21.44
Plant 10	5.15	2.44*	2.11	6.90	2.73	1.34	1.11	2.66	24.95*	10.39*	69.51	1.03*	1.76	31.61
Plant 11	5.17	2.29	2.25	7.12	2.59	1.37*	1.13	3.00	23.79*	9.16*	94.25*	0.93	1.74	28.56
Plant 12	5.25	2.33	2.25	7.36*	2.76*	1.40*	1.18*	3.00	20.79	7.62	87.58*	0.84	2.14*	31.85
Plant 13	5.13	2.34	2.18	6.36	2.74	1.24	1.17*	3.00	21.64	8.86*	85.87*	0.94	1.43	33.38
Plant 14	5.25	2.36	2.22	7.03	2.82*	1.34	1.19*	2.66	20.80	8.70	71.84	1.16*	1.93*	32.36
Plant 15	5.13	2.40*	2.14	7.12	2.76*	1.39*	1.15	2.33*	24.65*	8.47	66.26	0.96	1.73	37.82
Plant 16	5.12	2.42*	2.12	7.22*	2.79*	1.40*	1.15	3.00	20.93	10.34*	70.33	1.22*	1.82	33.56
Plant 17	5.22	2.40*	2.17	7.02	2.70	1.34	1.12	3.00	21.18	8.87*	92.78*	0.81	2.15*	29.55
Plant 18	5.21	2.39*	2.18	7.10	2.69	1.36*	1.12	3.00	23.52*	8.39	84.63*	1.33*	1.66	35.52
Plant 19	5.20	2.30	2.25	7.26*	2.66	1.39*	1.15	2.33*	21.64	6.46	76.84	0.84	1.75	33.47
Plant 20	5.18	2.39*	2.16	7.02	2.74	1.35	1.14	2.33*	22.14	8.43	92.88*	0.94	1.83	36.79
Grand mean	5.24	2.33	2.24	7.09	2.71	1.35	1.16	2.74	22.20	8.76	79.58	0.97	1.88	31.98
SE	0.014	0.021	0.021	0.028	0.021	0.007	0.007	0.183	0.233	0.035	1.732	0.014	0.028	-
CD (5 %)	0.05	0.06	0.06	0.08	0.07	0.02	0.03	0.54	0.68	0.10	4.94	0.04	0.08	-

nutritional characters. The most kernel L/B ratio was showed by plant 4 and 3 (2.30). The plant 9, 10 demonstrated the low in kernel L/B ratio of 2.11. For kernel length subsequent eating quality IR 72 (8.60 mm) showed significantly higher in comparatively mean values. Selected the twenty F_3 plants kernel length ranged from 6.36 to 7.81 mm. The most extreme was showed by plant 7 and 13. Plant 7 and 19 had significantly higher kernel length after cooking than the grand mean (7.09 mm). A sum of five chosen plants in F_3 plants was significant when compared to the grand mean (2.71 mm). The most mean appeared value was by plant 14 (2.82 mm) and the least plant 3 (2.55 mm). Mean an incentive for twenty chose F_3 plants ranged from 1.24 to 1.49. Chosen F_3 plants demonstrated significantly higher values than the grand mean (1.35). The chosen F_3 plants breadth wise expansion ratio ranged from 1.11 to 1.22 and the highest. The mean value of selected F_3 plants ranged from 2.00 to 3.00. Out of twenty chose F_3 plants, five plants *viz.*, plant 3 and 20 had significantly lesser mean values. Plant 15, 9, 11, 18 and 8 indicated together high in mean values compare than the grand mean (22.20).

Nutritional and grain quality characters were recorded on 20 plants selected in variability for F_3 generation of two crosses (Table 3 and Table 4). The phenotypic and genotypic coefficient of variation (PCV & GCV) for quality trait in IR 72 x Veeradangan was 6.10 and 6.05 respectively. In ADT 39 x Kavuni, the phenotypic and genotypic coefficients of variation (PCV &GCV) was 4.38 and 4.34 respectively. Similar findings were already reported by[7,13,17.]

More range of variability was found in IR 72 x Veeradangan (6.64 to 8.40 mm) whereas, ADT 39 x Kavuni (6.36 to 7.81 mm) was noticed in F_3 population. High heritability (83.80%) and moderate genetic advance (17.87) as per cent of mean was noticed in IR 72 x Veeradangan whereas, the cross ADT 39 x Kavuni registered high heritability (83.97%) with moderate genetic advance

Table 3 — Genetic variability parameters of F_3 population of the cross (IR 72 x Veeradangan) for grain quality and nutritional traits in rice

Traits	Range		Grand Mean	Coefficient of Variation (%)		Heritability (%)	Genetic advance as per cent of mean
	Minimum	Maximum		Phenotypic (PCV)	Genotypic (GCV)		
KL (mm)	5.39	6.54	5.99	6.10	6.05	88.44	12.37
KB (mm)	2.21	2.41	2.30	4.65	4.60	77.57	9.36
Kernel L/B ratio	2.23	2.92	2.60	8.36	8.30	91.65	16.99
KLAC (mm)	6.64	8.40	7.51	8.87	8.77	83.80	17.87
KBAC (mm)	2.60	2.86	2.68	3.74	3.49	86.97	6.70
LER (mm)	1.16	1.38	1.25	5.48	5.28	92.91	10.49
BER (mm)	1.10	1.21	1.16	2.89	2.50	72.21	4.48
ASV	2.00	4.00	3.07	25.38	24.48	93.02	48.64
AC (%)	18.45	24.39	22.09	8.52	8.34	95.83	16.83
Ca (mg/100 g)	5.39	7.65	6.64	10.86	10.64	95.58	20.41
Mg (mg/100 g)	61.43	97.63	80.67	17.91	17.86	93.96	36.79
Fe (mg/100 g)	0.53	1.03	0.80	27.56	27.42	95.03	56.22
Zn (mg/100 g)	1.51	1.98	1.82	16.67	16.59	98.99	34.00

Table 4 — Genetic variability parameters of F_3 population of the cross (ADT 39 X Kavuni) for grain quality and nutritional traits in rice

Traits	Range		Grand Mean	Coefficient of Variation (%)		Heritability (%)	Genetic advance as per cent of mean
	Minimum	Maximum		Phenotypic (PCV)	Genotypic (GCV)		
KL (mm)	5.12	5.37	5.24	4.38	4.34	91.17	8.86
KB (mm)	2.20	2.45	2.33	3.20	2.79	75.88	5.01
Kernel L/B ratio	2.11	2.40	2.24	6.11	5.87	92.38	11.63
KLAC (mm)	6.36	7.81	7.09	6.80	6.77	83.97	13.88
KBAC (mm)	2.55	2.82	2.71	3.22	2.73	71.81	4.77
LER (mm)	1.24	1.49	1.35	4.71	4.63	84.50	9.37
BER (mm)	1.11	1.22	1.16	3.40	2.88	72.22	5.05
ASV	2.00	3.00	2.74	16.24	10.95	45.45	15.20
AC (%)	20.12	24.95	22.20	8.00	7.78	91.60	15.60
Ca (mg/100 g)	6.46	10.39	8.76	15.69	15.67	95.80	32.25
Mg (mg/100 g)	53.38	94.25	79.58	17.98	17.58	95.60	35.42
Fe (mg/100 g)	0.61	1.33	0.97	23.94	23.77	96.55	48.61
Zn (mg/100 g)	1.43	2.16	1.88	16.40	16.19	97.47	32.93

(13.88) as per cent of mean. With regard to kernel breadth after cooking, IR 72 x Veeradangan showed low phenotypic and genotypic coefficients of variation of 3.74 and 3.49 respectively. The coefficients of phenotypic and genotypic variation were 3.22 and 2.73 respectively in ADT 39 x Kavuni.

The PCV and GCV for breadth wise expansion ratio in IR 72 x Veeradangan was 2.89 and 2.50 respectively. In the cross ADT 39 x Kavuni the phenotypic and genotypic coefficients of variation (PCV & GCV) was 3.40 and 2.88 respectively. ADT 39 x Kavuni recorded moderate heritability (45.45%) and genetic advance (15.20) as per cent of mean for this trait. These results were parallel with the findings of[2]. For amylose content wide range of variability was found in ADT 39 x Kavuni (20.12 to 24.95) and IR 72 x Veeradangan (18.45 to 24.39) in F_3 population. Similar findings were reported by[12,14]. Plant 5, 7, 8, 10, 11 and 14 for two grain quality and two nutritional characters showed significant mean value for four characters. High magnesium content in plant 11 (94.25 mg/100 g) followed by plant 8 and plant 7. Iron content was high in plant 18 followed by plant 7, 5 and 16 and zinc content was high in plant 4 (2.16 mg/100 g) followed by plant 12 and plant 6. Rice is a poor source of calcium and therefore insufficiency of calcium leads to malformation of skeleton and teeth, abnormal contraction of muscle and blood clotting. So from selected F_3 plants from the cross 1 (plants 10, 8, 11 and 9) and in 2 (plants 6, 10 and 16) can be forwarded for next generation.

Magnesium is also implicated to have a role in cardiovascular disease. Daily intake of magnesium to maintain balance is around 350 mg/day[6]. Because of these characters plants 4, 10, 18 in cross 1 and plants 11, 8, 7 in cross 2 were having high magnesium content so that can be selected for further study. This deficiency can be negotiated by improving varieties with high iron content. From cross 1 (plants 3, 8 and 18) and in cross 2 (plants 18, 7, 5 and 16) can be used for further breeding programme. Zinc is essential for co-factor in more than 200 compounds and assumes basic auxiliary plays in numerous protein and formation of transcriptional factors. Zn lacks in adult, juvenile and children causes hindered development and dwarfism, impeded sexual improvement, disabled feeling and lesser craving and stress lethargy[18,1]. The limit these lack of healthy sustenance indications the plants 4, 6, 10 of cross 1 and plants 4, 12 and 6 can be used for further breeding programme.

Simple correlation coefficient for grain quality attributes with single plant yield for selected F_3 plants have computed and given in Table 5 & Table 6. Kernel breadth (0.378), Magnesium content (0.457) had positive correlation with yield in IR 72 x Veeradangan. Alkali spreading value (-0.399) had negative correlation yield. Kernel breadth had positive and more significant correlation positively with kernel breadth after cooking (0.648). Kernel length after cooking had positive and significant correlation with liner elongation ratio (0.687). Linear elongation ratio had positive relation with amylose content (0.613). Alkali spreading value had positive relation with calcium content (0.511).

Alkali spreading value (-0.551) had negative correlation with ADT 39 x Kavuni F_3 population. In kernel length had positive inter correlation with kernel length after cooking (0.393) and zinc content (0.675). Kernel breadth had positive inter correlation with calcium content (0.410) whereas, relationship with negatively correlation with breadth wise expansion ratio (-0.556). Kernel L/B ratio had positive correlation with breadth wise expansion ratio (0.612) and negative correlation with kernel breadth after cooking. Kernel length after cooking had significant inter correlation relationship with linear elongation ratio (0.972). The characters that were having positive and significant inter correlation with kernel length. Similar results were reported by[13]. Kernel L/B ratio showed positive correlation with kernel length. Kernel breadth after cooking exhibited positive and significant inter correlation with breadth wise elongation ratio. These results were similar to the findings of[10]. The alkali spreading value resulted in positive and significant inter correlation with amylose content and calcium content respectively. The calcium content inter correlated with zinc content. In ADT 39

Table 5 — Simple correlation coefficient for selected F_3 plants of the cross (IR 72 x Veeradangan) for grain quality and nutritional traits in rice

Characters	KB (mm)	KLBR	KLAC (mm)	KBAC (mm)	LER (mm)	BER (mm)	ASV	AC (%)	Ca (mg/ 100 g)	Mg (mg/ 100 g)	Fe (mg/ 100 g)	Zn (mg/ 100g)	SPY (g)
KL (mm)	0.265	0.867**	0.728**	0.042	0.022	-0.245	0.062	-0.004	-0.148	-0.018	-0.106	-0.083	-0.081
KB (mm)		-0.247	0.147	0.648**	-0.052	-0.409*	0.028	0.322	-0.258	-0.053	0.095	0.298	0.378*
KLBR			0.648**	-0.299	0.038	-0.048	0.052	-0.169	-0.014	0.021	-0.146	-0.242	-0.119
KLAC (mm)				-0.132	0.687**	-0.323	0.063	-0.379	-0.053	-0.024	-0.010	-0.084	-0.050
KBAC (mm)					-0.197	0.426*	0.167	0.119	-0.323	-0.232	0.148	0.101	0.078
LER (mm)						-0.178	0.073	0.613**	0.108	-0.067	0.016	0.026	-0.221
BER (mm)							0.188	-0.232	-0.085	-0.207	0.068	-0.272	-0.370
ASV								-0.044	0.511*	-0.205	-0.203	0.060	-0.399*
AC (%)									-0.217	0.080	-0.297	-0.211	0.256
Ca (mg/100 g)										-0.118	-0.252	0.458*	-0.220
Mg (mg/100 g)											0.076	-0.264	0.457*
Fe (mg/100 g)												-0.045	0.090
Zn (mg/100 g)													0.211

* Significant at 5% level ** Significant at 1% level

Table 6 — Simple correlation coefficient for selected F_3 plants of the cross (ADT 39 x Kavuni) for grain quality and nutritional traits in rice

Characters	KB (mm)	KLBR	KLAC (mm)	KBAC (mm)	LER (mm)	BER (mm)	ASV	AC (%)	Ca (mg/ 100 g)	Mg (mg/ 100 g)	Fe (mg/100 g)	Zn (mg/100 g)	SPY (g)
KL (mm)	-0.393*	0.633**	0.393*	- 0.066	0.175	0.517**	0.174	-0.209	-0.217	0.116	-0.087	0.675**	-0.195
KB (mm)		-0.958**	0.165	0.607**	0.281	-0.556**	0.165	0.305	0.410*	-0.244	0.088	-0.104	-0.072
KLBR			-0.017	-0.501*	-0.179	0.612**	-0.083	-0.209	-0.393	0.209	-0.104	0.301	-0.004
KLAC (mm)				0.288	0.972**	0.099	0.224	-0.022	-0.166	0.138	0.307	0.356	-0.372
KBAC (mm)					0.298	0.316	0.133	-0.066	-0.167	-0.223	0.306	0.218	0.110
LER (mm)						-0.021	0.183	0.393*	-0.128	0.114	0.353	0.211	-0.333
BER (mm)							-0.040	0.052	-0.349	0.074	0.225	0.325	0.217
ASV								0.041	0.269	0.204	0.249	0.064	-0.551**
AC (%)									0.156	-0.154	-0.006	-0.244	-0.046
Ca (mg/100 g)										-0.276	0.016	0.016	-0.239
Mg (mg/100 g)											0.297	0.065	0.081
Fe (mg/100 g)												-0.223	0.169
Zn (mg/100 g)													-0.128

x Kavuni, quality traits showed no direct correlation with single plant yield. Alkali spreading value showed negative significance with single plant yield. Kernel length showed indirect positively significant correlation with kernel L/B ratio and zinc content. Kernel breadth was significantly inter correlated with calcium content The kernel length after cooking were positive and significantly inter correlated. Rice is predicted by the high amylose content which is the single main vital factor. The amylose operate as diluent as well at the same time as an inhibitor of swelling of rice starch granules.

Conclusion

India is home for number of rice assortments that have well therapeutic and nutritional along with great grain qualities. There is urgent need to conserve these landraces that are fast disappearing under the pressure of high yielding modern varieties. When food is nutritionally biofortified contain essential supplements, the farmer who engorge can develop indefinitely without extra contribution to increase in a sustainable way. Overall among in land races Kavuni followed by Veeradangan, were found to be superior for increased macro and micro nutrients with good grain quality characters. Overall F_3 segregants and cross combinations were chosen dependent mainly in single plant yield. To estimation with the more yielding cultivars and therapeutic landraces for calcium content for bone strength, the landrace Kavuni had high micronutrients content. In iron content most extreme have enlisted by the landrace have high amount micronutrients and Kavuni positions originally pursued followed by Veeradangan, Kathanellu and Navara. Old land races have in rice genetic resources for India are accounted to immense measure of genetic decent variety having therapeutic nature and aroma[3]. *In situ* conservation of land races found in the biodiversity for assurance of the land races, heritage, socio economic structure of the farmers[15].

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