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Genetic variability studies in segregating generation for grain and nutritional quality traits in rice (*Oryza sativa* L.)

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Abstract: The experimental materials used were four traditional landraces and six improved high yielding varieties of Tamil Nadu raised in during kharif 2012-2014. Genetic variability parameters on F_3 population (20 selected F_3 plants) of two cross combination *viz.,* IR 72 x Veeradangan and ADT 39 x Kavuni in F_3 population depicted wide range of variability and its ranged from 6.46 to 10.39 mg/100 g while it was from 5.39 to 7.65 mg/100 g in IR 72 x Veeradangan F_3 population. Calcium content for IR 72 x Veeradangan in selected F_3 population recorded wide range of variability and its ranged from 61.43 to 97.63 mg/100 g with a mean value of 80.67 mg/100 g whereas, ADT 39 x Kavuni in F_3 population revealed the low range of variability and its ranged from 53.38 to 94.25 mg/100 g with a mean value of 79.58 mg/100 g for magnesium content. For iron content, IR 72 x Veeradangan in F_3 population showed wide range of variability and its ranged from 0.53 to 1.03 mg/100 g with a grand mean of 0.80 mg/100 g whereas, ADT 39 x Kavuni in F_3 population ranged from 0.61 to 1.33 mg/100 g and from with a grand mean value of 0.97 mg/100 g. For zinc content, wide range of variability was found in ADT 39 x Kavuni (1.43 to 2.16 mg/100 g) and in IR 72 x Veeradangan (1.51 to 1.98 mg/100 g) in F_3 population.

Keywords: Genetic advance, Grain quality, Heritability, Nutritional traits, Rice, Variability

INTRODUCTION

Rice (*Oryza sativa* L.), a member of poaceae family, is one of the world's most important food crops, feeding more than half of the world's population. In India, over 50 per cent of all children receive insufficient calories everyday to meet their potential growth and development requirements (Mahendra *et al*., 2004). Crop improvement in rice depends on the magnitude of genetic variability and the extent to which the desirable genes are heritable (Savitha and Ushakumari, 2014). Importance of landraces is larger than life in agriculture system, because improvement in existing variety depends upon desirable genes which are possibly present in land races and wild varieties only. Quality of rice may be considered from the view point of size, shape and appearance of grain, milling quality and cooking properties (Dela and Khush, 2000). Iron deficiency anemia is by far the most common micronutrient deficiency in the world affecting more than two billion people. Minerals are essential for normal metabolic functions and are required components in balanced diet. Brown rice is an excellent source of minerals. Since, all the four medicinal landraces studied were of brown and black rice, they could be the best source for minerals especially calcium and magnesium content in human beings.

Calcium is the essential element required for the formation and maintenance of skeleton and teeth. It is required for normal contraction of muscle to make limbs move contraction of heart for its normal function, nervous activity and blood clotting. Magnesium plays an important in cardiovascular disease. Magnesium and calcium shares many of the properties of absorption and tissue distribution. Zinc is required as a co-factor in over 300 enzymes and plays critical structural role in many protein and transcriptional factors. Zinc deficiency is more extensive in developing countries where more than 60 per cent of the population is at risk. Zinc deficiency in grown up children and adolescent males causes retarded growth and dwarfism, retarded sexual development, impaired sense of taste and poor appetite and mental lethargy (Walker and Black, 2007). Coloured rice (black and red) is rich in minerals (iron and zinc) polyphenols and have antioxidant properties. Though the red of the grain colour is confined to the bran layer, a tinge of red remains even after a high degree of milling. The colour of the bran ranges from light to dark red. The zinc and iron content of red rice is 2-3 times higher than that of white rice. In order to enhance the micronutrient concentration in the grain suitable breeding programmes should be followed. Hence, critical assessment of nature and magnitude of genetic variability is one of the important prerequisites for formulating effective breeding methods in rice breeding (Sangeetha., 2013).

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Hence, this study was undertaken mainly to know the genetic architecture of yield contributing, quality and nutritive characters in different segregating generations in rice and to identify better segregants with improved nutritional parameters with higher yield when compared with the varieties cultivated.

MATERIALS AND METHODS

The present investigation was carried out during 2012 to 2014 using the experimental material consisting of five generations including, P_1, P_2, F_1, F_2 and F_3. The experimental material consisted of four medicinal landraces *viz.,* Veeradangan, Kavuni, Kathanellu and Navara which were collected from Tamil Nadu and Navara is a medicinal landrace of Kerala these landraces are having superior nutritional grain qualities and low yielder and six improved semi-dwarf high yielding varieties *viz.,* IR 72, ADT 39, ADT 45, ASD 16 and TPS 4 of medium grain quality along with standard check ADT 43 by adopting a spacing of 30 x 10 cm at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai during kharif 2012-14. Among the six crosses studied, IR 72 x Veeradangan and ADT 39 x Kavuni exhibited superior *per* se performance for biometrical traits in both F_2 and F_3 generations for almost all the economic characters studied including yield. Data were recorded 10 plants for replication in parents for 200 and 250 plants in F_2's and F_3's, respectively for days to 50 per cent flowering (days), plant height (cm), number of productive tillers per plant, number of filled grains per panicle, hundred grain weight (g) and single yield per plant (g) in single plant observation. The mean data for each character individually was subjected to statistical analysis. Grain quality characters *viz.,* kernel length, kernel breadth, kernel L/B ratio, kernel length after cooking, kernel breadth after cooking, linear elongation ratio, breadth wise expansion ratio, alkali spreading value and amylose content and nutritional characters *viz.,* calcium, magnesium, iron and zinc were recorded on 20 plants selected in F_3 generation of two crosses. Measurements were repeated more than three times for each varieties, land race and hybrids of the crosses. Standard statistical procedures were used for the analysis of variance, mean performance. 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 AND DISCUSSION

The potentiality of crosses is measured not only by mean performance but also on the extent of variability. Knowledge on nature and magnitude of phenotypic and genotypic variability present in any crop species plays an important role in formulating successful breeding programme (Allard, 1960). The genotypic coefficient of variation alone is not sufficient for the

Table 1. Genetic variability parameters for grain quality and nutritional traits in parents.

Characters	Range		Grand mean	Coefficient of variation (%)		Heritability (%)	Genetic advance as per cent of mean
	Minimum	Maximum		Phenotypic (PCV)	Genotypic (GCV)		
Hulling percentage (H %)	78.30	89.11	83.59	4.57	4.31	89.03	8.38
Milling percentage (M %)	64.09	77.83	71.56	6.24	6.04	93.78	12.06
Head rice recovery (HRR %)	51.38	68.13	58.63	9.51	9.30	95.55	18.73
Kernel length (KL-mm)	4.96	6.82	5.50	9.84	9.40	91.29	18.51
Kernel breadth (KB- mm)	2.01	2.81	2.34	11.94	11.61	94.61	23.27
Kernel L/B ratio (KLBR)	1.83	3.39	2.38	19.73	19.61	98.80	40.16
Kernel length after cooking (KLAC-mm)	6.20	8.53	7.05	13.26	12.88	94.35	25.77
Kernel breadth after cooking (KBAC-mm)	2.49	3.00	2.75	6.70	6.16	84.69	11.69
Linear elongation ratio	1.10	1.64	1.29	14.88	14.66	94.06	29.76
Volume expansion ratio (VER)	3.40	5.39	4.54	13.23	12.98	96.30	26.25
Alkali spreading value	3.33	4.66	3.93	17.64	10.14	33.08	12.02
Amylose content (AC %)	20.11	27.19	22.29	11.48	11.06	92.77	21.95
Calcium content (mg/100g)	6.03	12.30	7.54	25.98	25.86	97.12	53.04
Magnesium content (mg/100g)	46.14	131.59	81.36	39.24	39.14	99.50	80.43
Iron content (mg/100g)	0.51	1.61	0.80	49.25	48.26	96.02	92.43
Zinc content (mg/100g)	0.91	2.79	1.71	39.57	36.57	83.00	67.67

Table 2. 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/100g)	5.39	7.65	6.64	10.86	10.64	95.58	20.41
Mg (mg/100g)	61.43	97.63	80.67	17.91	17.86	93.96	36.79
Fe (mg/100g)	0.53	1.03	0.80	27.56	27.42	95.03	56.22
Zn (mg/100g)	1.51	1.98	1.82	16.67	16.59	98.99	34.00

Table 3. 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/100g)	6.46	10.39	8.76	15.69	15.67	95.80	32.25
Mg (mg/100g)	53.38	94.25	79.58	17.98	17.58	95.60	35.42
Fe (mg/100g)	0.61	1.33	0.97	23.94	23.77	96.55	48.61
Zn (mg/100g)	1.43	2.16	1.88	16.40	16.19	97.47	32.93

determination of the amount of heritable variation. According to Singh *et al.* (1974) the genes cannot express the character unless they have the proper environment for expression in conditions. The heritability estimate gives information on the extent to which available variation is heritable in nature. Genetic advance is an improvement in the genotypic value in the selected families over base population. Therefore the combination of mean, variability, heritability and genetic advance will be useful to make an efficient selection (Sivasubramanian and Menon, 1973). For this study, based on grain colour and single plant yield for biochemical analysis for 20 best single plants were selected in two crosses *viz.,* IR 72 x Veeradangan and ADT 39 x Kavuni (Tables 1,2 and 3).

Parental genotypes, for kernel length, the coefficient of variation due to phenotype and genotype were 9.84 and 9.40 respectively and kernel breadth after cooking recorded the phenotypic and genotypic coefficient of variation of 6.70 and 6.16 respectively. For kernel length, phenotypic and genotypic coefficient of variation for this trait in IR 72 x Veeradangan was 6.10 and 6.05 respectively and the cross ADT 39 x Kavuni, the phenotypic and genotypic coefficients of variation was 4.38 and 4.34 respectively. 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. Anilkumar (2008) studied the low phenotypic (8.13, 8.04) and genotypic coefficient of variability (7.13, 7.01) was observed for kernel length and kernel breadth after cooking in parental population. Low phenotypic (9.84, 9.40) and genotypic coefficient of variability (6.70, 6.16) was observed for kernel length and kernel breadth after cooking in parental and F_3 population of two crosses observed these results accordance with Anilkumar (2008). It indicates that there was a bottleneck for further improvement through selection. For parental genotypes, high heritability (91.29 per cent) and high genetic advance (18.51) as per cent of mean were recorded for kernel length. High heritability (88.44 per cent) and moderate genetic advance (12.37) as per of mean was noticed in IR 72 x Veeradangan whereas, in ADT 39 x Kavuni registered high heritability (91.17) with low genetic advance (8.86) as per cent of mean. In respect to kernel length, high heritability with moderate genetic advance as per cent of mean was recorded by parent while, selected F_3 population of the cross with high heritability and moderate to low genetic advance as per cent of mean. This indicates predominance of both additive and non additive gene action for this trait. These results were in accordance with the earlier findings of Krishnaveni *et al.* (2013) and Madakemohekar *et al.* (2013).

Kernel L/B ratio, volume expansion ratio in phenotypic and genotypic coefficient of variations was 19.73 and 19.61 per cent and 13.23 and 12.98 respectively in parental genotypes. With regard to kernel L/B ratio, IR 72 x Veeradangan showed low phenotypic and genotypic coefficients of variation of 8.36 and 8.30 respectively. Low phenotypic coefficient of variation (6.11) and genotypic coefficient of variation (5.87) was recorded in ADT 39 x Kavuni. For kernel L/B ratio and volume expansion ratio, moderate phenotypic (19.73, 13.23) and genotypic coefficient of variation (19.61, 12.98) was observed in parental population. Kalaimaghal (2011) revealed moderate phenotypic (18.54, 15.47) and genotypic coefficient of variation (17.48, 14.48) for kernel L/B ratio and volume expansion ratio high heritability (91.28. 84.16) with high genetic advance as per cent (38.48, 29.73) for kernel breadth and Kernel L/B ratio. Heritability and genetic advance as per cent of mean for kernel breadth was 94.61 per cent and 23.27 per cent for in parental genotypes. It had a heritability estimate of 98.80 per cent along with the genetic advance of 40.16 as per cent of mean in Kernel L/B ratio was observed in parental population. The findings of Sabesan *et al.* (2009), Umadevi *et al.* (2009) and Kalaimaghal (2011) revealed high heritability (91.28. 84.16) with high genetic advance as per cent (38.48, 29.73) for kernel breadth and Kernel L/B ratio.

For kernel breadth, the cross IR 72 x Veeradangan, high heritability of 77.57 per cent and low genetic advance 9.36 as per cent of mean was noticed. The cross ADT 39 x Kavuni recorded high heritability of 75.88 per cent coupled with low genetic advance 5.01 as per cent of mean. Kernel L/B ratio, the cross IR 72 x Veeradangan, high heritability of 91.65 per cent with moderate genetic advance 16.99 as per cent of mean was noticed. ADT 39 x Kavuni recorded high heritability of 92.38 per cent with moderate genetic advance 11.63 as per cent of mean. In selected F_3 population of two crosses were registered high heritability with low genetic advance as per cent of mean for kernel breadth and high heritability with moderate genetic advance as per cent of mean for kernel L/B ratio was observed. This indicates the predominance of both additive and non additive gene action for the expression of this trait, hence simple phenotypic selection is effective for further improvement which was in agreement with Sala (2012). For parental genotypes, the kernel length after cooking showed a heritability estimate of 94.35 per cent with the genetic advance of 25.77 as per cent of mean. Heritability and genetic advance as per cent of mean for this trait was 84.69 per cent and 11.69 respectively for kernel breadth after cooking and heritability estimate for linear elongation ratio was 94.06 per cent with the genetic advance of 29.76 as per cent of mean. High heritability (83.80 per cent) 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 per cent) with moderate genetic advance (13.88) as per cent of mean for kernel length after cooking. The coefficients of phenotypic and genotypic variation were 3.22 and 2.73 respectively in ADT 39 x Kavuni. In the cross IR 72 x Veeradangan, high heritability of 86.97 per cent with low genetic advance 6.70 as per cent of mean was noticed. ADT 39 x Kavuni recorded high heritability of 71.81 per cent with low genetic advance 4.77 as per cent of mean for kernel breadth after cooking. High heritability (92.91 per cent) and moderate genetic advance (10.49) as per cent of mean was noticed in the cross IR 72 x Veeradangan whereas, the cross ADT 39 x Kavuni registered high heritability (84.50) with low genetic advance (9.37) as per cent of mean in linear elongation ratio. In the cross ADT 39 x Kavuni the phenotypic and genotypic coefficients of variation was 3.40 and 2.88 respectively. High heritability (72.21 per cent) and low genetic advance (4.48) as per cent of mean noticed in IR 72 x Veeradangan whereas, in ADT 39 x Kavuni registered high heritability (72.22) with low genetic advance (5.05) as per cent of mean breadth wise expansion ratio. High heritability with high to low genetic advance as per cent of mean was observed for kernel length after cooking, kernel breadth after cooking, linear elongation ratio and breadth wise expansion ratio in both the parental and selected F_3 population of the two crosses. This indicated the predominance of both additive and non additive gene action for the expression of kernel length after cooking, kernel breadth after cooking, linear elongation ratio and breadth wise expansion ratio.

In the present investigation alkali spreading value exhibited moderate phenotypic (17.64) and genotypic coefficient (10.14) of variability for parents and high for IR 72 x Veeradangan (25.38, 24.48) and moderate for ADT 39 x Kavuni (16.24, 10.95) in F_3 population. Similar findings in alkali spreading value moderate phenotypic (14.13) and genotypic (13.83) observed in Babu *et al.* (2012). High heritability with high genetic advance as per cent of mean was observed for alkali spreading value in IR 72 x Veeradangan of F_3 population. Moderate heritability with moderate genetic advance as per cent of mean was observed in parental population and ADT 39 x Kavuni of F_3 population which indicated the predominance of additive gene action for the expression of this trait.9 Babu *et al.* (2012) recorded high heritability and high genetic advance for alkali spreading value.

Amylose content, the phenotypic and genotypic coefficients of variations was 11.48 and 11.06 respectively. The estimate of heritability and genetic advance as per cent of mean were 92.77 per cent and 21.95 per cent respectively in parental genotypes. The phenotypic and genotypic coefficient of variations for amylose content in IR 72 x Veeradangan was 8.52 and 8.34 respectively. In the cross ADT 39 x Kavuni, the phenotypic and genotypic coefficients of variation were 8.00 and 7.78 respectively. High heritability (95.83 per cent) and moderate genetic advance (16.83) as per of mean noticed in IR 72 x Veeradangan whereas, in ADT 39 x Kavuni registered high heritability (91.60 per cent) with moderate genetic advance (15.60) as per cent of mean. For amylose content moderate phenotypic (11.48) and genotypic coefficient of variability (11.06) was observed in parental population. Similar findings moderate phenotypic (16.48) and genotypic coefficient of variability (15.85) was observed in parental population were reported by Premkumar *et al*. (2012). High heritability (92.77) with moderate genetic advance (21.95) as per cent of mean was observed for amylose content, indicating the predominance of additive gene action for the expression of this trait in parental population and selected F_3 population of two crosses.

Parental genotypes, calcium content, the phenotypic coefficient of variation was 25.98 and genotypic coefficient of variation was 25.86. The heritability of this trait was 97.12 per cent and the genetic advance as percent of mean was 53.04. Calcium is the essential element required for the formation and maintenance of skeleton and teeth. It is required for normal contraction of muscle to make limbs move, contraction of heart for its normal function, nervous activity and blood clotting. Magnesium content for parental genotypes,, the coefficient of variation for phenotype and genotype were 39.24 and 39.14 respectively. Heritability and genetic advance as per cent of grand mean were 99.50 and 80.43 respectively. Magnesium and calcium shares many of the properties of absorption and tissue distribution. For parental genotypes, iron content, phenotypic coefficient of variation was 49.25 and genotypic coefficient of variation was 48.26. The heritability was 96.02 per cent and the genetic advance as percent of mean was 92.43. Parental genotypes, zinc content coefficient of variation for phenotype and genotype were 39.57 and 36.57 respectively. Heritability and genetic advance as percent of mean were 83.00 per cent and 67.67 respectively. Zinc is an important element performing a range of functions in the body as it is a co-factor for a number of enzymes.

Calcium content, phenotypic and genotypic coefficient of variations was 10.86 and 10.64 respectively in IR 72 x Veeradangan. Moderate phenotypic coefficient of variation (15.69) and genotypic coefficient of variation (15.67) were recorded in ADT 39 x Kavuni. In the cross IR 72 x Veeradangan, high heritability of 95.58 per cent with high genetic advance 20.41 as per cent of mean was noticed. ADT 39 x Kavuni recorded high heritability and genetic advance as per cent of mean 95.80 and 32.25 respectively. The phenotypic and genotypic coefficients of variation for magnesium content in IR 72 x Veeradangan were 17.91 and 17.86 respectively. In the cross ADT 39 x Kavuni the phenotypic and genotypic coefficient of variations were 17.98 and 17.58 respectively. High heritability (93.96 per cent) and moderate genetic advance (36.79) as per cent of mean noticed in cross IR 72 x Veeradangan whereas, cross ADT 39 x Kavuni registered high heritability (95.60 per cent) with low genetic advance (35.42) as per cent of mean. High calcium and magnesium contents could be helpful in improving muscle activity in patients suffering from muscle disorders. This is in accordance with finding of Deepa *et al.* (2008). With regard to iron content, IR 72 x Veeradangan showed high phenotypic and genotypic coefficients of variation of 27.56 and 27.42 respectively. High phenotypic coefficient of variation of 23.94 and genotypic coefficient of variation of 23.77 was recorded in ADT 39 x Kavuni. In the cross IR 72 x Veeradangan, high heritability of 95.03 per cent with high genetic advance 56.22 as per cent of mean was noticed. ADT 39 x Kavuni recorded high heritability and genetic advance as per cent of mean 96.55 and 48.61 respectively. Zinc content, recorded the phenotypic and genotypic coefficient of variation of 16.67 and 16.59 respectively for the cross IR 72 x Veeradangan. In the cross ADT 39 x Kavuni, the phenotypic and genotypic coefficient of variations were 16.40 and 16.19 respectively. High heritability (98.99 per cent) and genetic advance (34.00) as per cent of mean were noticed in IR 72 x Veeradangan whereas; in ADT 39 x Kavuni registered high heritability (97.47 per cent) with high genetic advance (32.93) as per cent of mean was observed.

Calcium (25.98, 25.86), magnesium (39.24, 39.14), iron (49.25, 48.26), zinc contents (39.57, 36.57) registered high and moderate phenotypic and genotypic coefficient of variability in parental genotypes and in F_3 population respectively. Govindaraj *et al.* (2011) stated that coefficient of variation was moderate for calcium (12.45) and zinc (18.34) contents and high coefficient of variation was found for iron (36.62). High heritability and genetic advance was noticed for zinc (99.90), iron (99.80) and calcium contents (99.00).

In respect of calcium, magnesium, iron and zinc contents high heritability with high genetic advance as per cent of mean was recorded by parental and selected F_3 population of the two crosses. This implies that the trait was controlled by additive gene action, which offers scope for further improvement through selection which were in agreement with Sala (2012). Selection based on the grain quality, nutritional traits will be help to improve the base parental population which may result in identification of best segregants (IR 72 x Veeradangan, ADT 39 x Kavuni) and coupled with yield improvement. Handling of segregating generation F_3 generation (IR 72 x Veeradangan, ADT 39 x Kavuni) is very important in a breeding programme as it serves as a prime source to understand the genetic variation present in the variable population, fixing desirable characters and to study the nature of relationship between yield and yield component traits and their direct and indirect effects on yield in the early generations are of great value in rice breeding. Through hybridization among the selected genotypes as parents, it is possible to inherit desired characteristics in the segregating population. Selection for quantitative characters is generally taken up in the early segregating population. Moreover, the basic aim of the plant breeder is to perpetuate the best progeny of the superior family.

Conclusion

Selection of parents based on a combination of parameters would increase the probability of success in any breeding programme. All the ten parents and two crosses of F_3 population *viz.,* IR 72 x Veeradangan and ADT 39 x Kavuni were selected based on the biometrical characters for grain quality studies. Twenty single plants were selected in F_3 generation in each cross good grain quality and nutritional traits. When comparing the high yielding varieties of rice and landraces for calcium content, the landrace Kavuni had high calcium content followed by Veeradangan, while Kathanellu had high magnesium content. For iron content maximum was registered by the landrace Kavuni, Veeradangan and Navara and for zinc content Kavuni ranks first followed by Veeradangan, Kathanellu and Navara. Comparing the released varieties the land races had double the amount of magnesium, iron and zinc contents. These selected plants in the above two crosses may be further advanced to later generations so as to select the best segregants for high single plant yield coupled with more nutritive content and grain quality. This implies that the trait was controlled by additive gene action, which offers scope for further improvement through selection.

REFERENCES

Allard, R.W. (1960). Principles of plant breeding. John Wiley and Sons. Inc., U.S.A. pp. 485.

Anilkumar, C.V. (2008). Genetic analysis of economic traits in segregating population of Rice (*Oryza sativa* L.). M.Sc. (Ag.) Thesis (Unpubl.), TNAU, Coimbatore.

Babu, R.V., Shreya, K., Dangi, K.S., Usharani, G. and Nagesh, P. (2012). Genetic variability studies for qualitative and quantitative traits in popular rice (*Oryza sativa* L.) hybrids of India. *Int. J. Scientific and Res. Publications,* 2(6): 1-5.

Burton, G.W. (1952). Quantitative inheritance in grasses. In: *Proc. 6th Inter Grassland Congr.,* 1: 277-283.

Dela, C.N and Khush, G.S. (2000). Rice grain quality evaluation procedures. Pp 15–28 In: Aromatic rices. Ed. Singh RK, Singh US, Khush GS. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.

Deepa, G., Singh V. and Naidu. K.A. 2008. Nutrient composition and physico-chemical properties of Indian medicinal rice – Njavara. *Food Che., 106:* 165-171.

Govindaraj, M., Selvi, B., Rajarathinam, S. and Sumathi, P. (2011). Genetic variability and heritability of grain yield components and grain mineral concentration in India's pearl millet. *AJFAND*, 11(3): 2011.

Kalaimaghal, R. (2011). Studies on genetic variability of grain iron and zinc content in F_2, F_3 generation of rice (*Oryza sativa* L.). M.Sc. (Ag.) Thesis (Unpubl.), TNAU, Coimbatore.

Krishnaveni, B., Vijayalakshmi, B. and Ramana, J.V. (2013). Divergance, variability and association studies for yield and quality parameters in rice. *ARRW Golden Jubilee Int. Symposium:* 29-30.

Lush, J.L. (1940). Correlation and regression of offspring on dams as a method of estimating heritability of characters. *Proc. American Soc. Animal Prodn.,* 33: 293-301.

Madakemohekar, A.H., Mishra, D.K., Koutu, G.K., Singh, S.K. and Goutam, Y.K. (2013). Yield and quality traits evolution of RIL's derived from inter subspecific crosses of rice (*Oryza sativa* L.). *ARRW Golden Jubilee Int. Symposium:* 57-58.

Mahendra, S., Ravi, C., Viswanathan, B., Gulati, A. and S. Ramchander. (2004). Economic liberalization, programs and household food security: A case study of India IFPRI. Markets, Trade and Industry (MTI) Discussion paper No.68.

Premkumar, R. (2012). Genetic studies on grain quality traits in rice (*Oryza sativa* L.). M.Sc. (Ag.) Thesis (Unpubl.), TNAU, Madurai.

Sala, M. (2012). Rice breeding for biofortification with high iron and zinc content in segregating population. M.Sc. (Ag.) Thesis (Unpubl.), TNAU, Madurai.

Sangeetha, L.N.E. (2013). Genetic variability studies for grain yield and grain quality traits in F_2 and F_3 population of rice (*Oryza sativa* L.). M.Sc. (Ag.) Thesis (Unpubl.), TNAU, Madurai.

Savitha P., and Usha Kumari R. (2014). Genetic performance of medicinal land races and improved cultivars for grain and nutritional quality traits quality in rice. *Oryza 51 (1):* 3-6.

Sabesan, T., Suresh, R. and Saravanan, K. (2009). Genetic variability and correlation for yield and grain quality characters of rice grown in coastal saline low land of Tamil Nadu. *Electron. J. of Plant Breeding, 1:* 56-59.

Singh, H.N., Singh R.R. and Mital, R.K. (1974). Genotypic and phenotypic variability in tomato. *Indian J. Agric. Sci.,* 44(12): 807-811.

Sivasubramanian, P. and Menon, P.M. (1973). Genotypic and phenotypic variability in rice. *Madras Agric. J.,* 60: 1093 -1096.

Umadevi, M., Veerabadhiran P. and Manonmani S. (2009). Genetic variability heritability, genetic advance and correlation for morphological traits in Rice Genotypes. *Madras Agric. J.,* 96(7-12): 316-318.

Walker, C.L.F. and Black, R.F. (2007). *Food and nutrition. Food Nutr. Bull.,* 23, pp. 454- 479.