Received: 18 May 2020 | Revised: 19 Jun 2020 | Accepted: 29 Jun 2020

Electronic Journal of Plant Breeding

Research Article

Genetic variability, correlation and path coefficient studies in F_2 generation of short slender aromatic and medium slender non-aromatic rice (*Oryza sativa* L.)

R. Sathishkumar[1], R. P. Gnanamalar[1*], R. Suresh[3], G. Anand[1] and S. Vellaikumar[2]

[1]Department of Plant Breeding and Genetics,
[2]Department of Biotechnology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai – 625 104, Tamil Nadu, India
[3]Tamil Nadu Rice Research Institute, Aduthurai – 612 101, Tamil Nadu, India
***E-Mail**: malarjustin@gmail.com

Abstract
Genetic variability, correlation, direct and indirect effects between yield and yield component traits were studied in the F_2 population of MDU 6 × VGD 1 and *Improved Samba Mashuri* × VGD 1 for six characters. Number of filled grains per panicle and single plant yield recorded high PCV, GCV and high heritability coupled with high genetic advance as per cent mean in both the crosses which indicated the presence of additive gene action and selection may be effective for these traits. Number of productive tillers per plant had moderate PCV, GCV, heritability and genetic advance as per cent mean in both crosses. Number of productive tillers per plant also had significant positive correlation with maximum direct effect on single plant yield in both the crosses. This indicated that the selection for high number of productive tillers per plant will bring concurrent improvement in yield as well.

Key words
Aromatic rice, GCV, PCV, Correlation, Path analysis.

INTRODUCTION

Rice is the staple and major food grain in India as well to the world. More than hundred countries are growing rice in an area of 158 Mha and the production is nearly 700 Mt annually. Among the food grain crops grown in India, rice has the largest area of about 38 Mha with the production of about 116 during 2018 - 2019 (www.indiastat.com). The population is expected to reach nearly 1.63 billion by the year 2050 (Ashok *et al.,* 2016). To feed the increasing population it is essential to increase the production and productivity. Aromatic rice such as Basmati and Jeeraga samba are known for their characteristic fragrance when cooked. They also fetch an additional price in local and regional markets and also add to India's foreign exchange reserve. The cultivation of basmati rice is mostly restricted within Northwestern states. Basmati fragrance does not appear in south India (Siddiq *et al.,* 2012). In South India, short slender aromatic rice is mainly preferred. Many landraces of short slender aromatic type are cultivated, but they are low yielders. Hence, improvement of short slender aromatic rice is being considered as important in rice breeding. Moreover, medium slender non-aromatic rice varieties with linear elongation without breadth wise elongation are highly preferred and this is one of the main objectives in rice improvement projects. Genetic variability in any segregating population is the base for genetic improvement and it is mainly based on the amount of variability present. In this experiment variability, heritability and association among yield and yield contributing traits were studied to understand the genetic makeup of the segregating population of short slender aromatic and medium slender non aromatic rice varieties.

MATERIALS AND METHODS

The experiment was conducted with the F_2 population of two crosses of *viz.,* MDU 6 × VGD 1 and *Improved Samba Mashuri* × VGD 1 at the research farm of the Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai during *kharif* 2019. Pedigree and salient features of the parents are given in the **Table 1**.The crop was raised with the spacing of 20 × 20 cm and all the recommended agronomic practices were followed. A total of 400 plants were raised in each cross and 150 segregants of short slender aromatic and medium slender non aromatic grain types were selected.

Observations were recorded on six quantitative traits *viz.,* plant height (cm), panicle length (cm), number of productive tillers per plant, number of filled grains per panicle, 100 grain weight (g) and single plant yield (g). The phenotypic and genotypic coefficients of variation (PCV and GCV) were calculated using the formula given by Burton and Devane (1953) and heritability and genetic advance by Johnson *et al.,* (1955). The correlation coefficient was calculated as per Goulden (1952), while the direct and indirect effects were estimated based on Dewey and Lu (1959).

Table 1. Parental details of crosses

Genotype	Parentage	Origin	Salient features
MDU 6	MDU 5 / ACM 96136	AC&RI, TNAU, Madurai.	High yielding Long slender variety with good grain quality.
Improved Samba Mashuri (ISM)	SM 4/ SS1113	IIRR, Hyderabad.	High yielding fine grain with resistance to bacterial blight.
VGD1	ADT43/ Jeeraga samba	ARS, Vaigai Dam	Short slender with mild aroma.

RESULTS AND DISCUSSION

The *per se* performance, range and genetic variability parameters were given in **Table 2.** The cross ISM × VGD1, showed higher mean value for most of the traits as compared to MDU 6 × VGD1. Both the crosses exhibited wide range of variation for most of the traits indicating enough opportunity for the improvement of yield. PCV and GCV were high for number of filled grains per panicle and single plant yield in both the crosses (**Fig.1**). Similar results were reported by Venkatesan *et al.,* (2019) for number of filled grains in F_3 and F_4 segregating generations of rice. Panicle length and number productive tillers per plant showed moderate PCV and GCV in both the crosses. Hundred grain weight exhibited high PCV and GCV in MDU6 × VGD1, whereas it was moderate in the F_2 of ISM × VGD1. The difference between PCV and GCV is very low which indicates the predominance of genetic factors.

High heritability coupled with high genetic advance as per cent mean was observed for all the characters except plant height and number of productive tillers per plant in MDU6 × VGD1, which indicated the predominance of additive gene action and selection may be effective for improvement of these traits. High heritability along with high genetic advance as per cent mean was noticed for number of productive tillers per plant, number of filled grains per panicle, hundred grain weight and single plant yield in the F_2 population of ISM × VGD1. Panicle length and plant height exhibited high heritability with moderate genetic advance as per cent mean in ISM × VGD1, this was agreement with Singh and Verma (2018) for panicle length. These characters are influenced by environment and selection will not be effective in the immediate generations. (**Fig.2**).

Table 2. ***Per se*** **performance, range and genetic variability parameters for yield and yield contributing traits.**

Characters	Mean		Range				PCV (%)		GCV (%)		h^2 in broad sense(%)		GA as % mean	
	Cross I	Cross II	Cross I		Cross II		Cross I	Cross II	Cross I	Cross II	Cross I	Cross II	Cross I	Cross II
			Min	Max	Min	Max								
Plant height (cm)	86.60	102.10	73.10	112.20	130.20	182.20	8.81	6.77	7.83	6.44	78.93	90.57	14.33	12.63
Productive tillers	24.00	28.25	16.00	33.00	11.00	36.00	13.86	14.82	11.64	13.83	80.85	87.17	14.68	26.61
Panicle length (cm)	24.75	28.04	11.30	29.30	16.20	32.40	18.57	11.48	17.81	10.26	92.02	79.71	35.20	18.56
Number of filled grains	116.31	140.25	89.00	216.00	83.00	310.00	31.35	31.74	30.66	30.64	95.62	93.01	61.77	38.04
100 grain weight (g)	1.05	1.43	0.82	2.44	0.78	1.98	40.68	16.99	39.94	15.97	96.40	88.32	80.79	30.92
Single plant yield (g)	19.05	25.00	8.40	45.90	5.60	35.20	45.21	32.55	44.11	31.59	95.17	94.21	88.65	63.17

PCV – Phenotypic coefficient of variation; GCV – Genotypic coefficient of variation; h^2 = Heritability; GA – Genetic advance; Cross I – MDU6 × VGD1, Cross II – ISM × VGD1

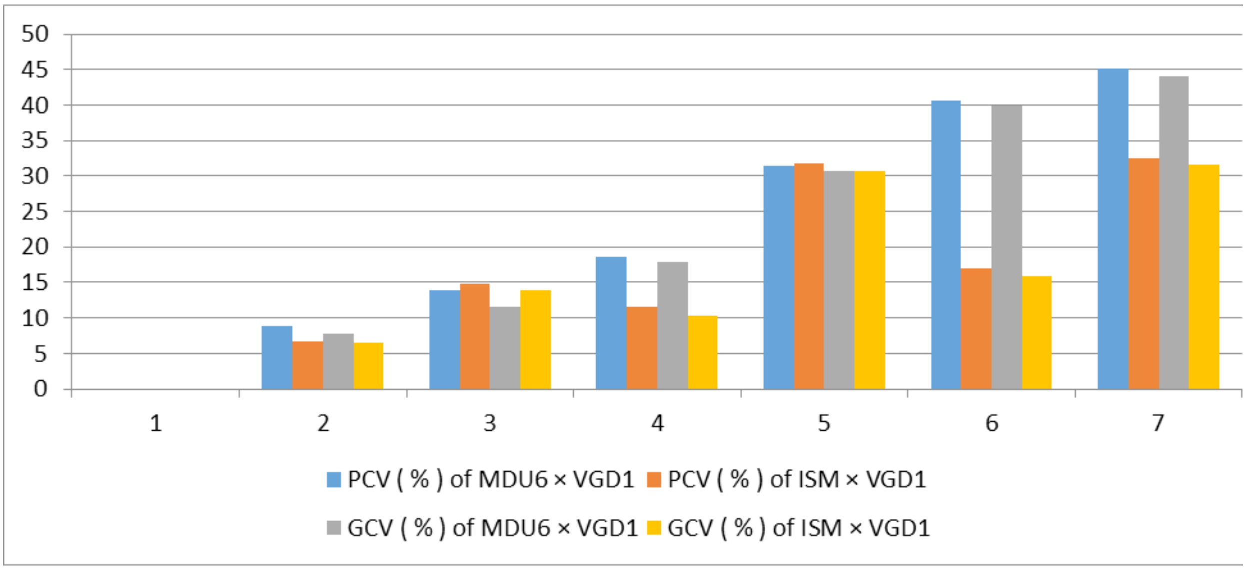

Fig. 1. PCV and GCV for grain yield and yield component traits

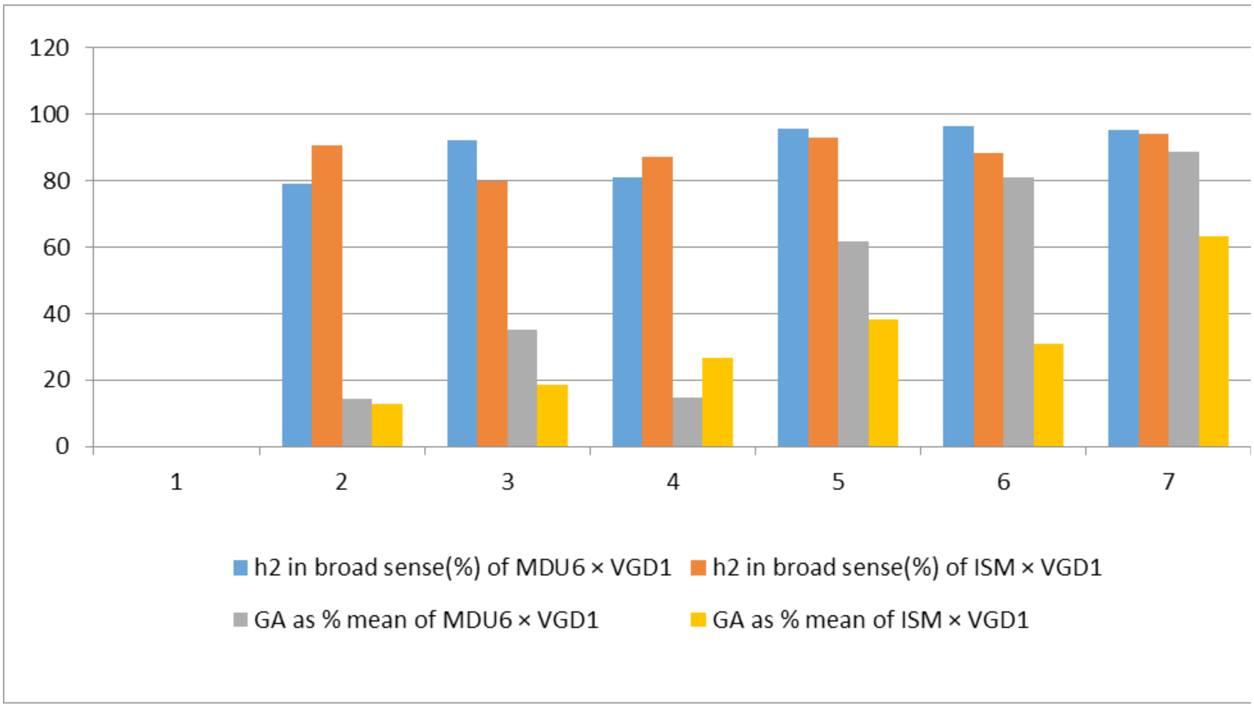

Fig. 2. Heritability and Genetic Advance as per cent mean for grain yield and yield component traits

https://doi.org/10.37992/2020.1102.085

Table 3. Correlation coefficients among grain yield and yield components in F_2 generation of MDU6 × VGD1 and ISM × VGD1

Characters	Crosses	PH	NPT	PL	NFG	HW	SPY
PH	MDU6 × VGD1	1.000	0.342**	0.282**	0.243**	0.148	0.365**
	ISM × VGD1	1.000	- 0.061	0.070	0.163*	-0.007	0.086
NPT	MDU6 × VGD1		1.000	0.198*	0.582**	0.094	0.349**
	ISM × VGD1		1.000	0.243*	- 0.091	0.101	0.673**
PL	MDU6 × VGD1			1.000	0.305*	0.106	0.024
	ISM × VGD1			1.000	- 0.058	- 0.001	0.321**
NFG	MDU6 × VGD1				1.000	- 0.124	0.227**
	ISM × VGD1				1.000	0.008	0.051
HW	MDU6 × VGD1					1.000	0.137
	ISM × VGD1					1.000	0.212**
SPY	MDU6 × VGD1						1.000
	ISM × VGD1						1.000

*, ** Significant at P=0.05 and P=0.01
PH - Plant height NFG - Number of filled grains per panicle
PL - Panicle length HW - Hundred grain weight
NPT - Number of productive tillers SPY - Single plant yield

The inter and intra correlation values of different yield component traits with yield were presented in **Table 3.** Plant height, number of productive tillers per plant and number filled grains per panicle showed significant positive correlation with single plant yield in MDU 6 × VGD 1. The results were in accordance with that of Asante *et al.,* (2019). Plant height had significant and positive inter correlation with number of productive tillers per plant, panicle length and number of filled grains per panicle. Similar findings were reported by Chhangte and Devi (2019). Number of productive tillers per plant had positive and significant inter correlation with panicle length and number of filled grains per panicle. Panicle length exhibited significant and positive inter correlation with number of filled grains per panicle.

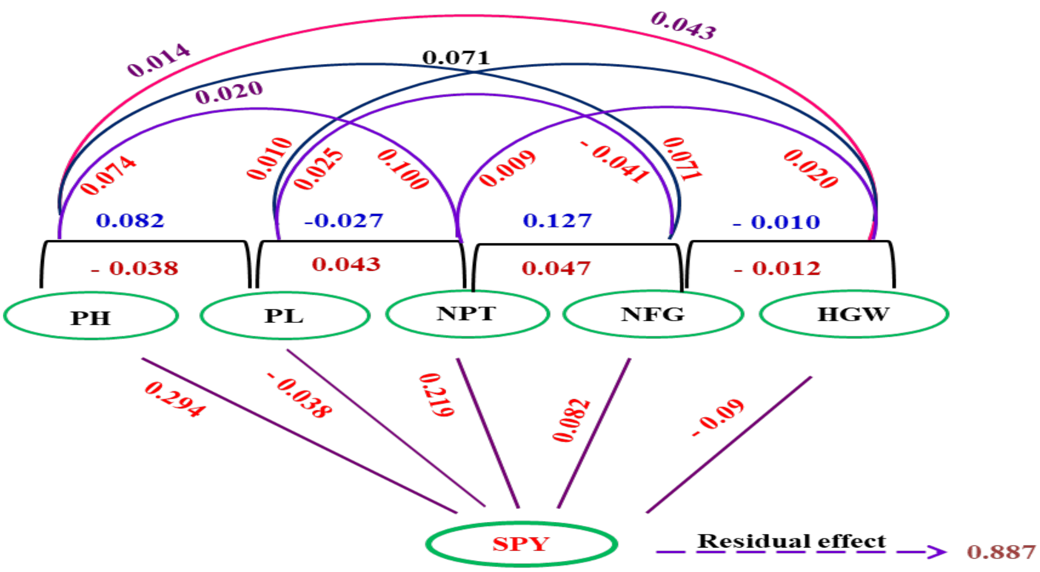

Fig. 3. Direct and indirect effects of yield contributing traits with single plant yield in F_2 generation of MDU6 × VGD1

In ISM × VGD 1 F_2 population, number of productive tillers per plant and hundred grain weight recorded significant and positive correlation with single plant yield. Plant height exhibited positive and significant inter correlation with number of filled grains per panicle. Number of productive tillers per plant recorded significant and positive inter correlation with panicle length and the same was reported by Nanda *et al.,* (2019). Strong inter correlation among these traits indicated that selection of these traits will bring concurrent improvement in the yield.

Plant height exerted positive and moderate direct effect on single plant yield in MDU 6 × VGD1. Number of productive tillers per plant showed positive and moderate direct in MDU 6 × VGD1, whereas it was positive and high in ISM × VGD 1. The similar results were confirmed by Chhangte and Devi (2019) for moderate direct effect and by Roy *et al.,* (2015) for high direct effect. The residual effect of the cross MDU 6 × VGD 1 is very high (0.887) implies that some other character also contributing towards the single plant yield apart from the characters under study. (**Fig.3 & 4**).

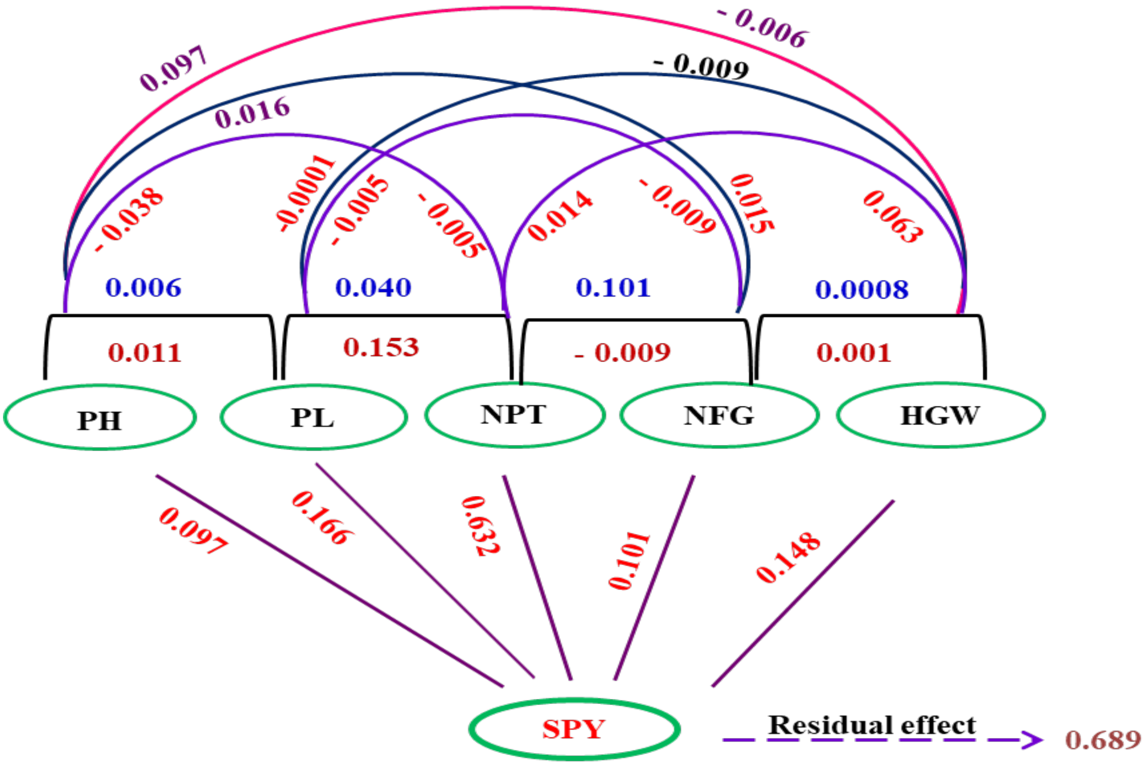

Fig. 4. Direct and indirect effects of yield contributing traits with single plant yield in F_2 generation of Improved Samba Mashuri × VGD1

The results showed that adequate genetic variability present in most of the traits in both the crosses. The difference between PCV and GCV was insignificant, which indicated the predominant role of genetic factors influencing the expression of the studied characters. The traits *viz.,* number of filled grains per panicle, hundred grain weight and single plant yield expressed high heritability coupled with high genetic advance as per cent mean in both crosses, which indicated the presence of additive nature of these traits. Correlation and path analysis revealed that number of productive tillers per plant should be given weightage for the improvement of the yield of short slender aromatic and medium slender non aromatic rice.

REFERENCES

Asante, Maxwell Darko, Kossi Lorimpo Adjah, and Ebenezer Annan-Afful. 2019. Assessment of genetic diversity for grain yield and yield component traits in Some genotypes of rice (*Oryza Sativa* L.). *Journal of Crop Science and Biotechnology* **22** (2):123-130. [Cross Ref]

Ashok, S., D.P.B. Jyothula, D. Ratna Babu, and V. Srinivasa Rao. 2016. Studies on genetic variability, heritability and genetic advance for yield components and grain quality parameters of rice (*Oryza sativa* L.). **63**(3):575-579.

Burton, Glenn W., and de E.H. Devane. 1953. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agronomy Journal* **45** (10):478-481. [Cross Ref]

Chhangte, Lalrinchhani, and Th. Renuka Devi. 2019. Correlation and path analysis studies in aromatic rice germplasm of North-East region of India. *The pharma Innovation Journal* 2019; **8**(10): 01-04

Dewey, Douglas R., and K.H. Lu. 1959. A correlation and path-coefficient analysis of components of crested wheatgrass seed production . *Agronomy Journal* **51** (9):515-518. [Cross Ref]

Goulden, C.H. 1952. "Probit analysis." *Method of statistical analysis, 2nd Ed: chapman & Hall Ltd*:394-417.

Johnson, Herbert W., H.F. Robinson, and R.E. Comstock. 1955. Estimates of genetic and environmental variability in soybean . *Agronomy Journal* **47** (7):314-318. [Cross Ref]

Nanda, Kalpataru, D.N. Bastia, and Ashutosh Nanda. 2019. Character association and path coefficient analysis for yield and its component traits in slender grain rice (*Oryza sativa* L.). *Electronic Journal of Plant Breeding* **10** (3):963-969. [Cross Ref]

Roy, Ripon Kumar, Ratna Rani Majumder, Shahanaz Sultana, M.E. Hoque, and M.S. Ali. 2015. Genetic variability, correlation and path coefficient analysis for yield and yield components in transplant aman rice (*Oryza sativa* L.). *Bangladesh Journal of Botany* **44** (4):529-535. [Cross Ref]

Siddiq, E.A., L.R. Vemireddy, and J. Nagaraju. 2012. Basmati rices: Genetics, breeding and trade. *Agricultural Research* **1** (1):25-36. [Cross Ref]

Singh, Neha, and O. Verma. 2018. Genetic variability, heritability and genetic advance in rice (*Oryza sativa* L.) under salt stressed soil. *J. Pharmacognosy Phytochemistry* **7** (3):3114-3117.

Venkatesan, M., R. Eswaran, P. Karthikeyan, and K.R. Saravanan. 2019. Genetic variability studies in F_3 and F_4 segregating generations for yield and its components in rice (*Oryza sativa* L.). **2**: 10-14