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Genetic variability analysis in rice (*Oryza sativa* L.)

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Abstract
The genetic improvement of any crop mainly depends on the amount of genetic variability present in the population. To explore this variability, an effort was made to classify, understand the nature and magnitude of genetic variability among 95 rice genotypes for 27 yield and yield contributing traits. Analysis of variance revealed a wide and significant variation for all the 27 traits studied. A perusal of genetic parameters *viz*., phenotypic and genotypic coefficients of variation revealed less influence of environment on the characters under study for both two seasons and locations. Therefore, response to direct selection may be effective in improving these traits. All the characters under study for both the locations exhibited high heritability except alkali spreading value which showed lowest heritability: Implying that these characters were under control of additive gene action and direct selection of these traits would be effective for crop improvement.

Keywords: Rice, variability, yield

Introduction
India is the world's second largest rice producer and consumer next to China, about 90 per cent of all rice grown in the world is produced and consumed in Asian region. In Maharashtra, the total area occupied by this crop was about 1.465 million hectares with annual production of 3.276 lakh tonnes and average productivity of the state was about 2.24 t/ha, (Anonymous, 2021) [3]. In Konkan region, rice occupies an area of about 0.387 million hectares with an annual production of around 1.031 million tonnes and average productivity of the konkan was about 2.66 t/ha. The area under rice in konkan region is 26.41% of the total area in Maharashtra (0.387 million hectares). (Anonymous, 2021) [3].

The landraces maintained by farmers are endowed with tremendous genetic variability, as they are not subjected to subtle selection over a long period of time. This aids in the adaptation of landraces to wide agro-ecological conditions. This rich variability of complex quantitative traits with respect to maturity, growing adaptation and their physicochemical and organoleptic properties still remains unexploited. Land-races are also important genetic resources for resistance to pests and diseases; they provide "adaptability genes" for specific environmental conditions. Incorporation of adaptability genes from landraces could ensure optimum grain yield for the region (Vijayakumar *et al*., 2020) [29]. It is very difficult to judge whether observed variability is heritable or not. Heritability indicates the extent of transmissibility of a character into future generations.

Moreover, knowledge of heritability is also essential for selection of component traits for yield improvement. Genetic advance measures the difference between the mean genotypic values of selected population and the original population from which these were selected. Heritability estimates along with genetic advance is normally more helpful in predicting the genetic gain under selection than heritability estimates alone.

Material and Methods
The genotypic and phenotypic coefficients of variation, heritability (broad sense) and genetic advance as per cent of mean were estimated for 95 rice genotypes during first year at Shirgaon and second year at Karjat, respectively. The 95 genotypes were obtained from various sources as details given below.

Table 1: Experimental material along with source

SN	Genotype	Source	SN	Genotype	Source
I	Red kernel local lines		II	Restorer lines	
1	MO-6	ARS, Moncomba	25	KJT-1R	ARS, Karjat
2	MO-8		26	KJT-2R	
3	MO-13		27	KJT-3R	
4	MO-17		28	KJT-4R	
5	MO-19		29	PR-114	IIRR, Hyderabad
6	Khara Rata	KRS, Panvel	30	RTN 11-2-1-3	ARS, Shirgaon
7	Mayekar Bhat	ARS, Karjat	31	PR-118	IIRR, Hyderabad
8	Munga	ARS, Shirgaon	32	DRR-215	
9	Mahsad		33	RTN-69-1-1	ARS, Shirgaon
10	Waksal-207		34	NAUR-1	NAU, Navsari
11	Barmil		35	BL-184AR	ARS, Karjat
12	Jyoti		36	Gurjari	NAU, Navsari
13	Patani-6		37	DRR-50-12	IIRR, Hyderabad
14	Bhadas-79		38	DRR-363-5	
15	Pandy		39	DRR-50-13	
16	Dular		40	DRR-50-10	
17	Try-1		41	DRR-86-8	
18	Kochari	ARS, Shirgaon	42	IR-63879-195-2-2-3-2	IRRI, Manila,
19	Lal Patani		43	RTN-27-1-1-2	ARS, Shirgaon
20	Dodak		44	RTN-214-1-1-1-2	
21	Karhad		45	VDN-9-10-1	ARS, Vadgaon
22	Ratnagiri 7		46	VDN-10-18	
23	Bela		47	RTN-35-1-1	ARS, Shirgaon
24	Valai		48	Sahyadri 5 R	
			49	HRTMS-61	
			50	CR-3993-2-24-45-2	IIRR, Hyderabad
III	Aromatic lines		IV	Lines responsive to biotic and abiotic stresses	
51	P Basmati	IARI, N. Delhi	70	RS-1113	IIRR, Hyderabad
52	S Basmati		71	RP Bio 197	
53	Kothambir Sal	ARS, Karjat	72	RP-BIO-226	
54	Chinoor	PDKV, Akola	73	Ajaya	
55	P Sugandha-1	IARI, N. Delhi	74	KJT 1	ARS, Karjat
56	P Sugandha-3		75	KJT 2	
57	P Sugandha-4		76	IR-64	IRRI, Manila
58	P Sugandha-5		77	MUDGO	
59	Bhadasbhog	IIRR, Hyderabad	78	MILYANG 46	
60	CR2713-180		79	PTB 33	RARS, Pattambi
61	Kalanamak		80	MTU1010	RARS, Maruteru
62	NDR6315		81	BG 367-2	IRRI, Manila
63	P Samruddhi	MPKV, Rahuri	82	MILYANG 63	
64	Indrayani	ARS, Vadgaon	83	FL 478	
65	Dhanesal	IIRR, Hyderabad	84	MUT NS 1	
66	Ambemohar	ARS, Vadgaon	85	RATHU HEENATI	
67	K Shatabdi	ARS, Karjat	86	SINNA SIVAPPU	
68	Bhogwati	ARS, Radhanagari	87	IRRI 190	
69	Sugandha	VNMKV, Parbhani	88	IRRI 193	
			89	ARC 10550	
			90	S MAHSURI	IIRR, Hyderabad
			91	IRRI 123	IRRI, Manila
			92	IRRI 104	
			93	IRRI 192	
			94	Sonsali	IIRR, Hyderabad
			95	TN-1	

The observations were made on 30 plants or parts of 30 plants, which were divided among 3 replications (10 plants in each replication) as per the guidelines of PPV & FR Authority (Anonymous, 2009) [4].

Table 2: Observations recorded on 27 yield and yield contributing characters, including 14 measurable DUS descriptors along with abbreviations

SN	Character	Abbreviation	Remark
1	Days to 50% Flowering (Nos.)	DFF (Nos.)	Measurable DUS descriptor No. 20
2	Plant Height (cm)	PHT (cm)	Yield and yield contributing character
3	Stem Length Excluding Panicle (cm)	SLEP (cm)	Measurable DUS descriptor No. 29

4	Number of Tillers Plant^{-1}	TLPP (Nos.)	Yield and yield contributing character
5	Panicle Length of Main Axis (cm)	PLMA (cm)	Measurable DUS descriptor No. 33
6	Number of Spikelets Panicle^{-1}	SPP (Nos.)	Yield and yield contributing character
7	Fertility (%)	Fertility (%)	Yield and yield contributing character
8	Days to Maturity (Nos.)	DM (Days)	Measurable DUS descriptor No. 47
9	Test Weight of 1000 Grains (g)	TW (g)	Measurable DUS descriptor No. 50
10	Grain Length (mm)	GL (mm)	Measurable DUS descriptor No. 51
11	Grain Width (mm)	GW (mm)	Measurable DUS descriptor No. 52
12	Grain Yield Plant^{-1} (g)	GYPP(g)	Yield and yield contributing character
13	Straw Yield Plant^{-1} (g)	SYPP (g)	Yield and yield contributing character
14	Grain Yield/ Straw Yield Ratio	G/S	Yield and yield contributing character
15	Straw Yield/ Grain Yield Ratio	S/G	Yield and yield contributing character
16	Leaf Length (cm)	LL (cm)	Measurable DUS descriptor No. 16
17	Leaf Breadth (cm)	LB (cm)	Measurable DUS descriptor No. 17
18	Stem Thickness (cm)	ST (cm)	Measurable DUS descriptor No. 28
19	No. of Panicles Plant^{-1}	PPP (Nos.)	Measurable DUS descriptor No. 36
20	Decorticated Grain Length (mm)	DGL (mm)	Measurable DUS descriptor No. 54
21	Decorticated Grain Breath (mm)	DGB (mm)	Measurable DUS descriptor No. 55
22	DGL/DGB Ratio	L/B	Grain type determining character
23	Amylose Content (%)	AC (%)	Measurable DUS descriptor No. 59 and Biochemical Character
24	Zinc Content (ppm)	Zn (ppm)	Biochemical Character
25	Iron Content (ppm)	Fe (ppm)	Biochemical Character
26	Calcium Content (ppm)	Ca (ppm)	Biochemical Character
27	Alkali Spreading Value	ASV	Biochemical Character and cooking quality assessment Character

The data was recorded for all the characters whose mean values were subjected to analysis of variance to test the significance for each character as per the methodology proposed by Patterson and Williams (1976) [30]. The genotypic and phenotypic variances, as well as the genotypic and phenotypic coefficient of variations (GCV and PCV), were calculated by the formulae given by Burton (1953) [10]. Heritability in a broad sense was calculated using the formula given by Allard (1960) [31] and genetic advance (GA) as per cent mean was estimated by the formula given by Johnson *et al*. (1955) [16]. Genetic divergence among the genotypes was estimated using Mahalanobis' D2 statistics (1936) [19] and the germplasm was grouped into several clusters by Tocher's method as described by Rao (1952) [21].

Results and Discussion

Genetic variability, heritability and genetic advance

In any plant breeding programme variability and selection are indispensable. Success of plant breeding programme depends on extent of variability present in the material under study. More the variability better is the chance of selection. In the present study wide range of variability was observed among the genotypes for all character under the study.

Phenotypic Coefficient of Variation (PCV) is the resultant of combined action of genotype and environment over a genotype. Genotypic Coefficient of Variation (GCV), a component of total variation reflects the heritable portion. In the present study, experiment carried out at ARS, Shirgaon, the GCV values ranged from 5.82 to 45.67 per cent whereas, PCV values ranged from 5.91 to 46.02 per cent, similarly for experiment carried out at RARS, Karjat during *Kharif*, 2021, the GCV values ranged from 5.95 to 45.64 per cent whereas, PCV values ranged from 6.08 to 46.06 per cent.

As the PCV estimates were slightly higher than the corresponding GCV for the characters studied at both locations, it indicates that the characters were less influenced by the environment. Therefore, phenotypic selection would be effective for the improvement of these traits.

The results were in accordance with finding of Vanisree *et al.* (2013) [27] and Lingaiah *et al.* (2015) [18], Similar findings were reported by Senapati and Kumar (2015) [23] and Bhinda *et al.* (2017) [9] for grain length, Babu *et al.* (2012) [7], Pratap *et al.* (2012) [20], Dhurai *et al.* (2014) [12] and Arvind *et al.* (2019) [6] for decorticated grain length and Subbaiah *et al.* (2011) [26] and Dhurai *et al.* (2014) [12] for length/breadth ratio. Phenotypic coefficient of variation was found to be higher than their corresponding genotypic coefficient variation for all the traits under study at both the locations. The relative difference between phenotypic coefficient of variation and genotypic coefficient of variation was narrow for all the 27 characters evaluated, suggesting that these traits were less influenced by environmental effect. Hence selection for these traits may be effective based on their phenotypic values.

For ARS, Shirgaon location, High GCV and PCV values were observed for the traits *viz*., zinc content, plant height, stem length excluding panicle, number of spikelets panicle per panicle, grain width, decorticated grain breath, L/B ratio, amylose content, iron content, calcium content and grain yield plant-indicating that large amount of variation is present among the genotypes, whereas for RARS, Karjat location, High GCV and PCV values were observed for the traits *viz*., zinc content, plant height, stem length excluding panicle, number of spikelets per panicle, weight of 1000 grains, grain yield plant^{-1}, straw yield plant^{-1},leaf length, L/B ratio, amylose content, iron content, calcium content and grain yield plant-1 indicating that large amount of variation is present among the genotypes. Similar results were obtained by for panicle number per plant, Gangashetty *et al*. (2013) [13] and Veni *et al*. (2013) [28] for No. of spikelets panicle per panicle, and Gangashetty *et al*. (2013) [13], Veni *et al*. (2013) [28], Dhurai *et al*. (2014) [12], Gyawali *et al*. (2018) [14], Chuchert *et al. (*2018) [11] and Arvind *et al*. (2019) [6] and Bhargavi *et al*. (2022) [8] for grain yield plant^{-1}.

Heritability measures the transmission of character from one generation to next generation. Heritability also separates the portion of environmental variability from phenotypic variability, so utilizing in making effective selection. Thus, presence of higher magnitude of genetic variability along with the degree to which it is transmitted from one generation to another is equally important for effective selection. (Burton and Devane, 1953) [10].

Johnson *et al.* (1955) [16] suggested that heritability and the genetic advance when calculated together would prove more useful in predicting the resultant effect of selection based on phenotypic expression. He further emphasized that without genetic advance; the estimates of heritability will not be of practical value and suggested the concurrent use of genetic advance along with heritability. High heritability alone is not enough to make sufficient improvement through selection in genetic advance generations. High heritability was obtained all the characters except alkali spreading value for both the locations indicating that these characters were least influenced by environmental effect and selection may be effective. Similar results were found in the results of Sarangi *et al.* (2009) [22], Arvind *et al*., (2019) [6] and Bhargavi *et al*. (2022) [8] (Table 3 & Table 4).

Genetic advance is a measure of genetic gain under selection. The success of genetic advance under selection depends on heritability of the character under consideration. This indicates that though the character is less influenced by environmental effects, the selection for improvement of such trait may not be useful because, heritability is based on total genetic variance which includes fixable (additive) and non-fixable (dominance and epistatic) variance. For ARS, Shirgaon location, the genetic advance as per cent of mean was high for the characters *viz*., plant height, stem length excluding panicle, number of spikelets per panicle and calcium content. On the other hand, moderate genetic advance as per cent of mean was noted for days to 50% flowering, fertility %, days to maturity, straw yield per plant, leaf length and zinc content. Rest of the seventeen characters showed low genetic advance as per cent of mean. High heritability coupled with high genetic advance as per cent of mean was observed for the traits *viz*., plant height, stem length excluding panicle length and calcium content, which suggests that these characters are subjected to any selection scheme for exploiting fixable genetic variance will be highly effective. Whereas for location RARS, Karjat. The genetic advance as per cent of mean was high for the characters *viz*., plant height, stem length excluding panicle, number of spikelets per panicle, leaf length and calcium content. On the other hand, moderate genetic advance as per cent of mean was noted for days to 50% flowering, fertility %, days to maturity, straw yield per plant and zinc content. Rest of the seventeen characters showed low genetic advance as per cent of mean. High heritability coupled with high genetic advance as per cent of mean was reported for plant height, stem length excluding panicle, number of spikelets panicle^{-1}, leaf length and calcium implying that these characters were under control of additive gene action and direct selection of these traits would be effective for crop improvement. Similar reports were published by Shanthi and Singh (2001) [24], Babu *et al.* (2012) [7], Aditya and Bhartiya (2013) [2] and Dhurai *et al.* (2014) [12] for straw yield/ grain yield ratio. Dhurai *et al.* (2014) [12] and Islam *et al.* (2015) [15] for days to maturity, Islam *et al.* (2015) [15] for grain length, Abebe *et al.* (2017) [1], Singh and Verma (2018) [25] and for 50% flowering, Singh and Verma (2018) [25] for fertility (%) and Bhargavi *et al.* (2022) [8] (Table 3 & Table 4).

Table 3: Genetic parameters of yield and 27 yield contributing characters Location-1, Year-1 *Kharif* 2020 in rice (ARS, Shirgaon)

			Range				Variance/σ2			Coefficient of Variance							
SN	Characters	$\bar{X}$	Min.	Name	Max.	Name	$\sigma^2 g$	$\sigma^2 p$	σ^2_e	GCV %	PCV %	ECV %	h^2 (bs)	GAM (5%)	SE±	CD (5%)	CV %
1	DFF (Nos.)	91.48	73.00	IRRI-104	112.00	Kalanamak	49.91	51.56	1.65	7.72	7.85	1.40	97.00	14.32	0.74	2.07	1.40
2	PHT (cm)	123.67	78.37	MO-8	192.33	NDR6315	650.23	666.44	16.21	20.62	20.87	3.26	98.00	51.89	2.32	6.48	3.26
3	SLEP (cm)	96.86	54.83	MO-8	156.67	NDR6315	595.79	610.89	15.10	25.20	25.52	4.01	98.00	49.66	2.24	6.26	4.01
4	TLPP (Nos.)	11.56	8.93	Mahsad	21.73	TN-1	2.84	3.35	0.51	14.57	15.82	6.16	85.00	3.20	0.41	1.15	6.16
5	PLMA (cm)	26.87	22.13	IRRI-104	35.67	NDR6315	5.23	6.46	1.23	8.51	9.46	4.13	81.00	4.24	0.64	1.79	4.13
6	SPP (Nos.)	131.45	55.31	IRRI-190	300.48	Ajaya	1654.31	1712.62	58.32	30.94	31.48	5.81	97.00	82.35	4.41	12.30	5.81
7	Fertility (%)	86.00	57.54	Try-1	98.07	IRRI-192	61.81	62.43	0.62	9.14	9.19	0.92	99.00	16.11	0.46	1.27	0.92
8	DM (Days)	121.48	103.00	IRRI-104	142.00	Kalanamak	49.91	51.56	1.65	5.82	5.91	1.06	97.00	14.32	0.74	2.07	1.06
9	TW (g)	21.83	11.22	Bhadasbhog	29.13	Bela	17.83	19.22	1.39	19.34	20.08	5.40	93.00	8.38	0.68	1.90	5.40
10	GL (mm)	9.42	5.99	Kothimbir sal	11.65	Sugandha	1.05	1.12	0.07	10.83	11.18	2.76	94.00	2.05	0.15	0.42	2.76
11	GW (mm)	2.87	2.23	S. Mahsuri	3.90	Kochari	0.13	0.14	0.01	12.55	12.79	2.48	96.00	0.73	0.04	0.11	2.48
12	GYPP(g)	17.11	9.22	Dular	32.27	PR-118	18.61	19.62	1.01	25.21	25.88	5.86	95.00	8.66	0.58	1.62	5.86
13	SYPP (g)	23.35	12.33	Dular	46.33	PR-118	36.78	38.63	1.85	25.98	26.62	5.83	95.00	12.19	0.79	2.19	5.83
14	G/S ratio	0.74	0.51	Chinoor	0.94	Gurjari	0.01	0.01	0.00	10.23	12.25	6.75	70.00	0.13	0.03	0.08	6.75
15	S/G ratio	1.37	1.07	Gurjari	1.96	Chinoor	0.02	0.03	0.01	11.23	13.13	6.80	73.00	0.27	0.05	0.15	6.80
16	LL (cm)	49.62	30.37	RTN-214-1-1-1-2	71.60	Patni-6	97.28	97.86	0.57	19.88	19.94	1.52	99.00	20.26	0.44	1.22	1.52
17	LB (cm)	1.10	0.70	Bhadas-79	1.50	CR-3993-2-24-45-2	0.03	0.04	0.01	15.04	17.64	9.22	73.00	0.29	0.06	0.16	9.22
18	ST (cm)	0.74	0.50	RTN-214-1-1-1-2	1.00	Patni-6	0.01	0.02	0.01	14.48	17.89	10.51	66.00	0.18	0.04	0.13	10.51
19	PPP (Nos.)	10.56	7.93	Mahsad	20.73	TN-1	2.84	3.35	0.51	15.95	17.32	6.74	85.00	3.20	0.41	1.15	6.74
20	DGL (mm)	6.76	4.03	Kothimbir sal	8.17	Sugandha	0.77	0.78	0.01	12.94	13.03	1.48	99.00	1.80	0.06	0.16	1.48
21	DGB (mm)	2.42	1.61	HRTMS-61	3.11	Bela	0.10	0.11	0.01	12.68	13.59	4.89	87.00	0.59	0.07	0.19	4.89
22	L/B ratio	2.85	1.41	Kothimbir sal	4.30	P. Basmati	0.34	0.38	0.04	20.29	21.41	6.83	90.00	1.14	0.11	0.32	6.83
23	AC (%)	23.15	11.67	MUDGO	34.99	Ajaya	22.59	23.74	1.15	20.53	21.04	4.63	95.00	9.55	0.62	1.73	4.63
24	Zn (ppm)	11.95	1.09	KJT-2R	22.62	PTB-33	29.78	30.24	0.47	45.67	46.02	5.71	99.00	11.15	0.39	1.10	5.71
25	Fe (ppm)	13.11	1.70	Mahsad	28.00	Kalanamak	22.98	23.40	0.42	36.58	36.91	4.96	98.00	9.79	0.38	1.05	4.96
26	Ca (ppm)	53.53	3.63	Sugandha	102.00	Bhogawati	394.28	396.88	2.60	37.09	37.22	3.01	99.00	40.77	0.93	2.60	3.01
27	ASV (Nos.)	4.59	3.00	Jyoti	5.33	RP-BIO226	0.24	0.81	0.57	10.60	19.57	16.45	29.00	0.54	0.44	1.22	16.45

Note- Red - Lowest, Blue- Highest, Orange- Low, Yelllow- Moderate and Green- High

Table 4: Genetic parameters of yield and 27 yield contributing characters Location-2, Year-2 *Kharif* 2021 in rice (RARS, Karjat)

SN	Characters	$\bar{X}$	Range				Variance/σ2			Coefficient of Variance			h^2 (bs)	GAM (5%)	SE±	CD (5%)	CV %
			Min.	Name	Max.	Name	$\sigma^2 g$	$\sigma^2 p$	σ^2_e	GCV %	PCV %	ECV %					
1	DFF (Nos.)	90.41	72.33	IRRI-104	111.33	Kalanamak	51.34	53.59	2.25	7.93	8.10	1.66	96.00	14.45	0.87	2.41	1.66
2	PHT (cm)	123.91	77.14	MO-8	193.22	NDR6315	638.10	655.30	17.21	20.39	20.66	3.35	97.00	51.35	2.39	6.68	3.35
3	SLEP (cm)	96.63	53.03	MO-8	156.75	NDR6315	581.94	597.10	15.16	24.97	25.29	4.03	98.00	49.06	2.25	6.27	4.03
4	TLPP (Nos.)	12.20	9.60	Mahsad	22.38	TN-1	2.85	3.41	0.56	13.84	15.13	6.11	84.00	3.18	0.43	1.20	6.11
5	PLMA (cm)	27.28	22.21	Gurjari	36.47	NDR6315	5.16	6.59	1.43	8.33	9.41	4.38	78.00	4.14	0.69	1.93	4.38
6	SPP (Nos.)	131.61	55.50	Dodak	301.00	Ajaya	1655.32	1716.41	61.10	30.92	31.48	5.94	96.00	82.31	4.51	12.59	5.94
7	Fertility (%)	86.06	57.54	Try-1	98.34	IRRI-192	62.43	63.04	0.62	9.18	9.23	0.91	99.00	16.20	0.45	1.26	0.91
8	DM (Days)	120.41	102.33	IRRI-104	141.33	Kalanamak	51.34	53.59	2.25	5.95	6.08	1.25	96.00	14.45	0.87	2.41	1.24
9	TW (g)	21.71	10.74	Bhadasbhog	29.29	Bela	18.71	20.15	1.44	19.92	20.67	5.53	93.00	8.59	0.69	1.93	5.53
10	GL (mm)	9.42	6.03	Kothimbir sal	11.65	Sugandha	1.05	1.12	0.07	10.86	11.19	2.70	94.00	2.05	0.15	0.41	2.70
11	GW (mm)	2.84	2.07	S. Mahsuri	3.91	Kochari	0.14	0.16	0.02	13.32	14.13	4.73	89.00	0.73	0.08	0.22	4.73
12	GYPP(g)	16.94	9.24	Dular	30.64	PR-118	17.85	18.88	1.02	24.95	25.65	5.97	95.00	8.47	0.58	1.63	5.97
13	SYPP (g)	22.70	8.60	Bhdas-79	46.50	PR-118	36.59	38.77	2.18	26.65	27.43	6.50	94.00	12.11	0.85	2.38	6.50
14	G/S ratio	0.84	0.59	HRTMS-61	0.88	RTN-214-1-1-1-2	0.01	2.21	2.20	13.86	17.31	17.77	91.00	0.02	0.86	0.02	6.77
15	S/G ratio	1.34	0.84	Bhdas-79	1.73	HRTMS-61	0.01	0.03	0.01	10.11	12.27	8.49	52.00	0.18	0.07	0.18	8.49
16	LL (cm)	49.52	30.40	RTN-214-1-1-1-2	71.69	Patni-6	99.33	100.07	0.74	20.13	20.20	1.74	99.00	20.46	0.50	1.39	1.74
17	LB (cm)	1.07	0.47	RTN-214-1-1-1-2	1.58	CR-3993-2-24-45-2	0.03	0.07	0.05	14.76	24.91	20.07	75.00	0.19	0.12	0.35	20.07
18	ST (cm)	0.76	0.51	RTN-214-1-1-1-2	1.06	RP-BIO-226	0.01	0.02	0.01	14.42	17.66	10.21	67.00	0.19	0.05	0.13	10.21
19	PPP (Nos.)	11.05	7.98	Mahsad	21.38	TN-1	3.18	3.83	0.64	16.15	17.71	7.27	83.00	3.35	0.46	1.29	7.27
20	DGL (mm)	6.78	4.01	Kothimbir sal	8.14	Sugandha	0.77	0.78	0.01	12.87	12.96	1.46	99.00	1.79	0.06	0.16	1.46
21	DGB (mm)	2.42	1.61	HRTMS-61	3.11	Bela	0.09	0.11	0.02	12.67	13.61	4.97	87.00	0.59	0.07	0.19	4.97
22	L/B ratio	2.85	1.41	Kothimbir sal	4.34	P. Basmati	0.34	0.37	0.04	20.14	21.27	6.84	90.00	1.13	0.11	0.32	6.84
23	AC (%)	23.01	11.86	MUDGO	35.01	Ajaya	22.63	23.82	1.19	20.67	21.21	4.74	95.00	9.55	0.63	1.76	4.74
24	Zn (ppm)	11.99	1.12	KJT-2R	22.59	PTB-33	29.92	30.47	0.55	45.64	46.06	6.20	98.00	11.17	0.43	1.20	6.20
25	Fe (ppm)	13.16	1.83	RP-BIO-226	28.12	Kalanamak	22.87	23.39	0.52	36.32	36.73	5.48	98.00	9.74	0.42	1.16	5.48
26	Ca (ppm)	54.06	3.86	Sugandha	102.68	BG-367-2	397.04	400.70	3.66	36.86	37.03	3.54	99.00	40.86	1.10	3.08	3.54
27	ASV (Nos.)	4.59	3.00	Jyoti	5.33	RP-BIO-226	0.25	0.79	0.55	10.79	19.36	16.08	28.00	0.57	0.43	1.19	16.08

Note- Red - Lowest, Blue- Highest, Orange- Low, Yelllow- Moderate and Green- High

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