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CLASSIFICATION AND VARIABILITY STUDYOF RICE (*Oryza sativa* GENOTYPES BASED ON SEED AND SEEDLING CHARACTERS

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ABSTRACT

The experiment was conducted to evaluate the locally grownrice genotypesalong with improved cultivars of rice collected from various parts of Raichur district of Karnataka and were evaluated for seed and seedling characters.A significant amount of genetic variation was displayed for most of the traits examined. 60 rice genotypes were used in lab condition for seed and seedling characters with three replications. Theassociationsamong seed and seedling components, and theirdirect and indirectinfluenceon the grain yieldof ricewere investigated.Dhelisanna, ADT-43, Surgeon, Kari jiddu, GGV 05 02, 27P04 and K -108 are the promising genotypes for seed and seedling characters. To exploit their genetic potential, thesegenotypes can beneficially be used in the breeding programs.

KEY WORDS
Seedling traits
Association
Grain size, grain length, grain shape and mal-nutrition

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INTRODUCTION

Rice (*Oriza sativa*) being the staple food for almost two thirds of the population plays an important role in Indian economy. Moreover, India ranks first in the world area of rice cultivation with 43.97 million ha and second in production with 104.32 million tons (Anonymous, 2013). Almost 31% calories of Indian diet are supplied through rice. Research efforts focused on development of high yielding varieties and adoption of modern production technologies resulted in enhanced production leading in self-sufficiency in the country. Therefore being the staple food of the population inIndia, improving its productivityhas becomes a crucial importance (Subbaiah *et al*., 2011). Along with yield, grain and nutritional quality has become a primary consideration in rice breeding programs not only in India but also in various rice growing countries across the world (Ravindra Babu, 2013).

The structure of rice grain is separated into three parts. The germ is the heart of grain, which sprouts when seed is planted. It is rich in vitamin B, vitamin E, protein, unsaturated fats, minerals, carbohydrates and dietary fiber. The endosperm constitutes the largest part of the grain. It is composed chiefly of carbohydrates in the form of starch, with some incomplete protein and trace of vitamins and minerals. Bran is the covering and is composed primarily of carbohydrate cellulose with trace of vitamin B, minerals and incomplete proteins. The rice grain contains 80% starch, 7.5% protein, 0.5% ash and 12% water (Ravindra Babu, 2013).

Rice grain size is a main component of rice appearance quality and which also has a direct effect on the marketability or commercial success of improved cultivars (Redona and Mackill, 1998 and Rabiei*et al*., 2004). Appearance quality is mainly determined by grain shape as specified by grain length, grain width and length to width ratio (Teng *et al*., 1992). The importance of rice quality depends on the factors that include end use of the grain and ethnic background of consumer and these differ widely, which is based on a combination of subjective and objective factors. Improvement of grain quality is the aim of all breeders, though it is a complex trait and rice research can accomplish this in several ways.

In rice, seedling vigor has been found to be associated with seed size and density as well as other parameters of germinating seed (Pandey *et al*., 1992 and Shenoy, 1990). However, the associations among seed and seedling traits are not clearly understood and there is a need to evaluate the available variability to identify genotypes with good appearance quality and early vigor for use in breeding.

MATERIALS AND METHODS

The experimental material consists of 60 rice genotypes, which comprising of local land races collected in and around Raichur district of Karnataka, improved cultivars and locally grown popular hybrids. The lab experiment was conducted

in department of Genetics and Plant Breeding University of Agricultural Sciences Raichur. 25 seeds were soaked in Petri plates. The fallowing Observations were recorded with three replications, *viz.,* Germination percentage, Root length 10th DAS(cm), Shoot length 10th DAS(cm), Root length 14th DAS(cm), Shoot length 14th DAS(cm), Seedling height (cm), Seedling dry weight (mg), Grain length (mm), Grain width (mm), Grain shape (L/B) ratio and 1000 Grain weight(g)as per Standard Evaluation System for rice by IRRI. Grouping of genotypes was done as per the procedure given by (Rosta, 1975) for length, (Ramaiah and Roa, 1953) for width and (IRRI, SESR, 1996) for Grain shape (L/B) ratio. The SPSS software is used for statistical analysis like ANOVA and associations of different traits.

RESULTS AND DISCUSSION

The analysis of variance for different characters is presented in Table 1. The treatments *i.e.* mean sum of squares due to genotypes showed significant differences for all characters under study at 5% level of significance suggesting that genotypes were genetically diverse.

Mean Performance

According to the mean performance Table 2 a wide range of variation was found for most of characters. Through this study an attempt was made to assess the mean performance and extent of variability in rice germplasms which depicts the mean performance of 60 genotypes for quantitative characters along with the standard error of difference and critical difference. The grain length ranged from 5.5mm to 12.33mm with the mean value of 8.36mm. The maximum grain length was recorded in genotype Dheli Sanna (12.33mm). The classification of rice genotypes based on grain length (Rosta 1975) presented in Table 4.The grain width ranged from 0.94mm to 2.16mm with the mean value of 1.78mm. The maximum grain width was observed in the genotype Uggibhatta (2.16).The classification of rice genotypes based on grain width is done based on Ramaiah&Roa(1953) resultspresented in Table 4. The wide range was observed in grain shape with 2.64mm to 7.76 with mean of 4.77. The maximum ratio was observed in the genotype GGV 05-02 (7.76).The classification of rice genotypes based on grain width is done based on IRRI, SESR, (1996) resultspresented in Table 4. The germination percentage ranged from 79.67% to 92.67% with the average of 86.34%. The highest germination was recorded in the genotypes were Dhelisanna, MRP 5041 and Gangotri (92.67%) The trait of root length was taken on 10th and 14th day after sowing (DAS). The range of root length at 10th day recorded was 9.09cm to 21.51cm with the mean performance of 13.44cm, at the same time range of root length at 14th observed was 11.12cm to 23.54cm with the mean value of 15.46cm. The longest root length in 10th and 14th DAS was observed in Surgeon (21.51cm and 23.54cm) respectively The shoot length trait was measured on 10th and 14th day after sowing (DAS). The range of shoot length at 10th day recorded was 6.74cm to 13.74cm with the mean performance of 9.17cm, while range of shoot length at 14th observed was 8.54cm to 15.55cm with the mean value of 10.97cm. The longest shoot length in 10th and 14th DAS was observed in surgeon (13.74cm and 15.55cm) respectivelyThe seedling height showed wide range of 21.52cm to 39.09cm with the mean performance of 26.48cm. The short seedling height was recorded by the Gandha sale (21.52cm).The longest seedling height was recorded by the Surgeon (39.09cm).The observation for the seedling dry weight was taken from the oven dried 14th day seedlings, which shows the maximum variability with the range from 9.50 mg to 27.60 mg, with the mean performance of 14.70mg. The maximum weight was observed in Dhelisanna (27.60 mg). The minimum weight was recorded in Parimlasanna(9.50 mg).The vigor index was ranged from 788.30to 2555.20 with the mean value of 1267.60. The highest Vigor index was observed in Dhelisanna (2555.20).

Variability parameters

Phenotypic coefficient of variation (PCV) was slightly higherin magnitude than the genotypic coefficient of variation (GCV)for all the characters indicating the influence of environmentalfactors on these traits Alok Kumar et al.,(2013) A wide range of PCVand GCV was observed (Table 3). Higher magnitude of phenotypic coefficient of variation was recorded for Grain Length (18.56 and 19.48), seed shape (20.64 and 22.67), 1000 seed weight (17.54 and 17.54), Shoot length at 10 DAS and seedling dry weight (21.38 and 21.38).Low variance was recorded for the germination percentage (3.5 and 3.75). The remaining characters were recorded moderately. The high magnitude of phenotypic variation were composed of high genotypiccoefficient of variations and less of the environment variations,which indicated high genetic variability for different traits andless influence of environment. Therefore selection on the basisof phenotype alone can be effective for the improvement ofthese traits. Similar results for low to moderate values of GCVand PCV were also found by Deosarkar *et al.* (1989), Sarkar *et al.* (2007), Prajapati *et al.* (2011), Singh *et al.* (2011), Ananadarao *et al.* (2011).

Heritability

The reliability of the phenotypic value depends on the estimatesof heritability for a particular character. Therefore highheritability helps in the effective selection for a particularcharacter. In the present investigation heritability in broadsense was calculated for all characters under study and ispresented in Table 3. Heritability is classified as high (above60%), medium (30%-60%) and low (below 30%).The

Table 1: ANOVA for Seed and seedling characters in rice

	Mean Sum Squares												
Source	Df	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
Genotypes	59	7.49**	0.16**	3.12**	30.26**	28.75**	9.96**	7.56**	7.56**	9.96**	34.69*	2957.20**	226452.90**
Error	118	0.24	0.01	0.2	0.009	1.33	0.25	0.14	0.14	0.25	0.63	0.003	4650.44

X1Grain length(mm);X2 Grain width(mm);X3Grain shape(L/B) ratio;X41000 Grain weight(g);X5 Germination %;X6 Root length 10th DAS(cm); X7 Shoot length 10th DAS(cm);X8 Shoot length 14th DAS(cm); X9Root length 14th DAS(cm);X10Seedling height (cm);X11;X12Vigor indexSeedling dry weight(mg)

Table 2: Mean performance of 60 genotypes for Seed and Seedling characters

S.N	Genotypes	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
1	Mugadasugandh	10.53	2.00	5.28	16.53	85.33	11.42	8.10	13.45	9.91	23.36	15.60	1329.10
2	Sannanellu	9.03	1.94	4.66	21.53	84.00	12.21	7.43	14.24	9.24	23.48	16.40	1375.60
3	Karigajavali	8.50	1.80	4.72	17.64	88.67	15.37	9.36	17.4	11.16	28.55	14.00	1239.00
4	Chinnaponni	7.67	1.85	4.17	19.27	85.33	14.03	9.58	16.06	11.38	27.44	14.60	1244.10
5	NMS-2	8.07	1.87	4.34	18.70	83.33	12.46	11.62	14.48	13.43	27.91	15.60	1298.80
6	Coimbatore sanna	9.67	2.04	4.74	18.25	85.67	14.29	11.25	16.31	13.06	29.38	14.60	1249.20
7	Mysore sanna	8.00	1.81	4.43	16.42	85.33	12.47	8.38	14.49	10.18	24.68	11.40	972.50
8	Madras sanna	7.70	1.97	3.91	18.77	80.33	14.20	11.30	16.23	13.11	29.33	15.10	1212.20
9	Gham sale	6.23	1.74	3.59	16.53	79.67	13.02	10.31	15.05	12.12	27.17	12.60	1002.40
10	Bangarsanna	8.37	1.75	4.78	18.22	82.67	14.79	7.49	16.82	9.30	26.11	12.20	1008.30
11	Surgeon	8.77	2.14	4.11	26.25	88.33	21.51	13.74	23.54	15.55	39.09	18.60	1641.40
12	Tuyimalli	8.23	1.82	4.53	16.32	84.33	11.51	8.83	13.54	10.64	24.18	12.10	1020.20
13	Kichidi samba	7.73	1.77	4.36	18.17	86.33	12.75	10.18	14.77	11.99	26.76	14.80	1276.80
14	Mysore mallige	8.83	1.89	4.68	17.81	89.00	12.96	10.09	14.99	11.89	26.89	13.40	1191.00
15	Kappubasumati	8.90	1.73	5.20	15.81	88.67	15.11	10.65	17.14	12.46	29.6	14.90	1320.90
16	HMT	9.30	1.69	5.51	13.29	89.33	14.80	8.32	16.83	10.13	26.96	11.30	1007.80
17	Parimalasanna	6.87	1.68	4.10	11.41	83.00	12.23	9.77	14.26	11.57	25.83	9.50	788.30
18	Jeerigesanna	6.10	1.83	3.33	12.23	85.33	12.49	7.55	14.51	9.36	23.88	18.40	1569.30
19	Delhlisanna	12.33	1.98	6.24	24.12	92.67	12.69	7.90	14.72	9.71	24.42	27.60	2555.20
20	Uggibhatta	5.70	2.16	2.64	20.1	88.67	17.16	10.53	19.18	12.34	31.52	15.90	1409.50
21	Kyasakki	8.03	1.78	4.51	16.15	87.66	15.22	9.44	17.25	11.25	28.50	12.20	1067.90
22	Kagi sale	7.83	1.94	4.03	18.17	85.67	9.09	10.8	11.12	12.6	23.72	14.30	1224.80
23	Gourisanna	7.67	1.72	4.47	16.11	82.00	11.53	8.94	13.56	10.75	24.31	12.40	1016.00
24	Ratnachoodi	7.33	1.88	3.91	13.76	84.67	12.67	10.63	14.69	12.44	27.13	12.80	1082.20
25	Raja bhoga	8.53	1.95	4.38	23.06	88.33	12.98	9.14	15.00	10.95	25.96	14.50	1279.00
26	Kari jiddu	7.93	2.10	3.78	25.09	88.00	15.43	10.72	17.46	12.53	29.99	19.40	1705.60
27	Meese bhatta	8.07	1.99	4.05	22.47	88.33	15.48	10.59	17.50	12.40	29.90	17.40	1536.10
28	ADT 43	8.17	1.81	4.52	15.72	83.00	12.50	6.85	14.53	8.65	23.18	25.20	2089.80
29	Gandha sale	5.80	1.63	3.55	10.51	85.67	10.47	7.22	12.49	9.03	21.52	16.50	1413.20
30	Navaara	7.67	1.89	4.05	20.05	82.00	12.87	7.19	14.89	8.99	23.89	23.80	1949.80
31	Selumsanna	8.16	1.84	4.43	16.72	84.66	12.55	10.66	14.58	12.47	27.05	14.00	1183.80
32	Ambemohar	7.33	1.61	4.56	10.21	87.33	14.20	9.44	16.23	11.25	27.48	9.60	838.10
33	Raj kamal	6.27	1.98	3.17	14.41	85.33	16.28	10.85	18.30	12.65	30.96	14.20	1210.00
34	Burma black	9.83	1.89	5.38	22.12	82.33	13.37	9.49	15.39	11.29	26.69	18.20	1497.00
35	Raj mudi	8.83	1.83	4.86	15.45	84.00	14.90	10.42	16.93	12.23	29.15	14.10	1182.70
36	KH- 4(varanasi)	8.03	1.58	5.08	13.81	83.67	13.52	6.81	15.55	8.62	24.17	11.10	928.50
37	IET 19251	9.17	1.86	4.94	18.11	87.67	12.22	7.71	14.25	9.52	23.77	14.00	1225.60
38	NES 07-03-1	7.63	1.74	4.39	18.36	90.33	14.32	8.17	16.35	9.97	26.32	13.80	1245.00
39	GGV 05-02	12.10	1.56	7.76	17.85	88.33	11.26	6.74	13.28	8.54	21.82	14.00	1236.40
40	Badri	10.83	1.92	5.65	14.09	88.33	13.82	7.24	15.85	9.05	24.90	13.80	1218.10
41	Ratansagar	9.10	1.66	5.48	18.69	86.33	13.54	7.20	15.57	9.01	24.57	12.40	1069.00
42	Gangavatisanna	5.55	1.56	3.63	18.02	84.33	11.78	7.57	13.80	9.37	23.18	14.00	1180.40
43	Yaramallala	10.20	1.74	5.95	17.68	91.33	14.10	8.29	16.13	10.09	26.22	14.20	1295.10
44	GGV 05-01	6.26	1.81	3.45	18.18	92.33	12.25	7.32	14.28	9.13	23.41	14.10	1300.20
45	GV SAT	9.34	1.92	4.88	19.09	85.00	13.52	8.63	15.55	10.44	25.99	13.90	1181.20
46	Gidda emergency	5.93	1.39	4.26	20.13	88.67	14.91	10.30	16.94	12.11	29.05	14.30	1267.00
47	MTU 1010	11.03	2.03	5.43	19.16	87.00	14.27	9.29	16.29	11.10	27.39	14.20	1233.80
48	Nice emergency	7.17	1.81	3.95	17.80	84.67	11.55	8.18	13.58	9.98	23.57	13.90	1175.20
49	BPT 5204	6.33	0.94	6.71	19.88	83.00	11.98	8.75	14.01	10.55	24.56	13.90	1153.40
50	27P04	8.33	1.19	7.15	16.23	84.00	13.34	10.58	15.37	12.39	27.76	14.50	1217.10
51	K 108	10.66	1.40	7.62	18.15	87.66	12.41	10.23	14.43	12.04	26.47	14.30	1252.00
52	Super sona	10.00	1.78	5.62	12.70	87.67	14.38	11.30	16.40	13.11	29.51	13.70	1199.30
53	MRP 5041	10.33	1.94	5.34	21.93	92.67	11.28	7.11	13.30	8.92	22.22	13.50	1249.30
54	MRP 5042	10.17	1.59	6.43	19.85	86.00	12.27	9.19	14.29	10.99	25.29	14.20	1220.90
55	Supreme sona	7.33	1.31	5.59	23.93	83.33	14.33	10.76	16.36	12.56	28.92	13.80	1149.10
56	Gangavatisona	9.67	1.77	5.48	18.51	85.00	15.26	11.00	17.28	12.81	30.09	13.70	1162.9
57	Siri 1253	9.33	2.07	4.52	17.75	84.00	13.86	8.51	15.88	10.32	26.20	13.90	1165.90
58	Mohima	5.67	1.19	4.79	19.26	89.33	14.38	11.36	16.37	13.16	23.30	14.20	1220.90
59	Ankurpooja	8.33	1.90	4.39	19.15	92.33	13.52	7.24	15.55	9.05	29.53	14.10	1258.70
60	Gangotri	9.83	1.83	5.38	14.42	92.67	12.81	7.00	14.84	8.80	24.60	13.70	1263.30
	Mean	8.37	1.77	4.78	17.84	86.344	13.46	9.18	15.49	10.97	26.48	14.70	1267.60
	C.V.	5.91	6.08	9.38	0.52	1.34	3.77	4.13	3.28	3.45	2.60	0.04	2.99
	S.E.	0.29	0.06	0.26	0.05	0.67	0.29	0.22	0.29	0.22	0.40	0.03	39.37
	C.D. 5%	0.80	0.17	0.73	0.15	1.87	0.82	0.61	0.82	0.61	1.11	0.09	110.26

X1 Seed length (mm);X2 Seed width (mm);X3 Seed shape (L/B) ratio;X4 1000 seed weight (g);X5 Germination % X6 Root length 10th DAS (cm);X7 Shoot length 10th DAS (cm);X8 Root length 14th DAS(cm);X9 Shoot length 14th DAS (cm);X10 Seedling height (cm);X11 Seedling dry weight (mg);X12 Vigor index (%)

high heritability was observed for theallseed and seedling characters in this study.High heritability values indicate that

Table 3: Estimation of Mean, range and genetic parameters for seed and seedling characters of rice genotypes

S.N	Characters	Mean	Min	Max	VG	VP	GCV	PCV	h^2 (bs)	GA	GAM
1	Grain length(mm)	8.36	5.55	12.33	2.42	2.66	18.56	19.48	90.80	3.05	36.44
2	Grain width(mm)	1.78	0.94	2.16	0.05	0.06	12.65	14.04	81.20	0.42	23.50
3	Grain shape(L/B) ratio	4.77	2.64	7.76	0.97	1.18	20.64	22.67	82.90	1.85	38.70
4	1000 grain weight(g)	18.13	10.21	26.25	10.08	10.09	17.54	17.54	99.80	6.54	36.11
5	Germination %	86.34	79.67	92.67	9.14	10.47	3.50	3.75	87.30	5.82	6.74
6	Root length 10th DAS(cm)	13.44	9.09	21.51	3.24	3.49	13.36	13.88	92.60	3.57	26.49
7	Shoot length 10th DAS(cm)	9.17	6.74	13.74	2.47	2.62	17.12	17.61	94.50	3.15	34.28
8	Root length 14th DAS(cm)	15.46	11.12	23.54	2.47	2.62	14.3	14.71	94.50	3.15	28.64
9	Shoot length 14th DAS(cm)	10.97	8.54	15.55	3.23	3.49	11.61	12.06	92.60	3.57	23.02
10	Seedling height (cm)	26.48	21.52	39.09	11.35	11.99	12.49	12.83	94.70	6.70	25.04
11	Seedling dry weight(mg)	14.70	9.50	27.60	9.86	9.86	21.38	21.38	99.70	64.68	44.03
12	Vigor index (%)	1267.60	788.30	2555.20	77695.73	78009.58	11.91	12.27	99.60	543.31	23.79

VG Phenotypic variance;VP Genotypic variance;PCV Phenotypic coefficient of variation (%);GCV Genotypic coefficient of variation (%);h^2 Heritability (%);GA Genetic advance; GAM Genetic advance as % of Mean

Table 4: Classification of grains into different classes based on physical characters in rice genotypes with corresponding to root and shoot length

Grain weight classification.																
	Mean						RL10 (cm)		SL10 (cm)		RL14 (cm)		SL14 (cm)		SDWT (mg)	
Groups	No. of genotypes	RL10	SL10	RL14	SL14	SDWT	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Light (12 - 18 g)	23	13.34	9.06	15.37	10.86	140.48	11.26	16.28	6.73	11.3	13.28	18.3	8.54	13.11	110.97	251.79
Medium (18 - 23 g)	32	13.34	9.12	15.35	10.93	147.13	9.09	17.16	6.99	11.62	11.12	19.18	8.8	13.43	121.97	237.79
Heavy (> 23 g)	5	15.65	10.38	17.68	12.18	200.04	12.69	15.43	7.9	10.72	14.72	17.46	9.71	12.53	144.79	275.75
Grain length classification (Rosta 1975).																
	Mean						RL10 (cm)		SL10 (cm)		RL14 (cm)		SL14 (cm)		SDWT (mg)	
Groups	No. of genotypes	RL10	SL10	RL14	SL14	SDWT	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Short (<7.5mm)	15	9.37	11.18	13.31	15.34	138.3	10.47	17.16	9.03	13.16	7.22	11.36	12.49	19.18	94.97	183.9
Medium (7.5-9.0 mm)	25	9.49	11.29	13.70	15.72	150.37	9.09	21.51	8.62	15.55	6.81	13.74	11.12	23.54	110.97	251.79
Long (9.0 - 10.0 mm)	20	8.68	10.49	13.21	15.23	149.04	11.26	15.26	8.54	13.11	6.73	11.3	13.28	17.28	112.82	275.75
Grain width classification (Ramaiah&Roa, 1953).																
	Mean						RL10 (cm)		SL10 (cm)		RL14 (cm)		SL14 (cm)		SDWT (mg)	
Groups	No. of genotypes	RL10	SL10	RL14	SL14	SDWT	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Narrow (<1.49 mm)	8	10.33	12.13	13.56	15.58	141.4	11.98	14.91	10.55	13.16	8.74	11.36	14	16.94	137.9	144.9
Medium (1.5-1.99mm)		45	10.33	12.13	13.56	15.58	141.4	9.09	16.28	8.54	13.43	6.73	11.62	11.12	18.3	94.97
275.75																
Broad (>2.0mm)	7	10.31	12.11	15.42	17.45	160.11	11.42	21.51	9.91	15.55	8.1	13.74	13.45	23.54	138.8	193.82
Grain shape (L/W ratio) classification (IRRI, SESR, 1996).																
	Mean						RL10 (cm)		SL10 (cm)		RL14 (cm)		SL14 (cm)		SDWT (mg)	
Groups	No. of genotypes	RL14	SL10	RL14	SL14	SDWT	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Slender (>3.0)	59	9.18	10.99	13.39	15.41	146.73	9.09	21.51	8.54	15.55	6.73	13.74	11.12	23.54	94.97	275.75
Medium (2.1 - 3.0)	1	10.53	12.34	17.16	19.18	158.97	17.16	17.16	12.34	12.34	10.53	10.53	19.18	19.18	158.97	158.97
Bold (1.1 -2.0)																
Round (<1.1)																

the charactersunder study are less influenced by environment in theirexpression. The plant breeder, therefore adopt simple selectionmethod on the basis of the phenotype of the characters whichultimately improves the genetic background of these traits.Similar results were also quoted by (Bisne et al., 2009), (Subbaiah *et al.,* 2011), Alok (Kumar et al., 2013) and (Ananadarao *et al.,* 2011).

GeneticAdvance

The estimates of genetic advance as per cent of mean providemore reliable information regarding the effectiveness ofselection in improving the traits. Genetic advance denotes theimprovement in the genotypic value of the new populationover the original population. Genetic advance estimates aredepicted in Table 3. The highest Genetic advance in percent mean were observed in Gerain Length (36.44), Grain Shape or L/B ratio (38.70), 1000 grain weight (36.11), Shoot Length at 10th DAS (34.28) and Seedling Dry weight (44.03). the lowest Genetic gain as percent of mean were recorded from Germination percentage (6.74).Similar results were alsoreported by (Iftekharuddaula *et al,*.2001),(Rakesh Kumar*et al*., 2013).Since broad sense heritability includes both additive andepistatic effects. It will be reliable only when accompanied byhigh genetic advance. Heritability estimates along with geneticadvance is more useful than heritability alone in predictingthe effectiveness of selection (Johnson *et al.,*1955). In thepresent investigation the characters which showed high heritabilityassociated with high genetic advance are Gerain Length, Grain Shape, 1000 grain weight, Shoot Length at 10th DAS and Seedling Dry weight. The characters that showhigh heritability coupled with high genetic advance arecontrolled by additive gene action (Panse and Suhatme, 1957) and can

be improved through simple or progeny selectionmethods while the characters which showed high heritabilitycoupled with moderate or low genetic advance can beimproved by intermitting superior genotypes of segregatingpopulation developed from combination breeding (Samadhia,2005). In the present investigation high heritability couplewith high genetic advance for yield attributing characters is in accordance with the (Satyanaryan *et al*., 2005), (Jaiswal *et al.,* 2007); (Subbaiha *et al.,* 2011) (Seyoum *et al*., 2012);

Seedlingvigor is most important trait to select the genotypes at seedling stage for yield. In our investigation the promising genotypes are Dhelisanna,ADT-43, Surgeon, Kari jiddu,Surgeon, GGV 05-02, 27P04 and K 108 for grain shape, test weight, seedling vigor and other seedling traits. Based on seed and seedling traits we can select the suitable genotypes in early stages for development of hybrids.

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