GENETIC VARIABILITY STUDY OF LOCAL RICE GENOTYPES

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ABSTRACT

Rice is a self- pollinating, major staple food crop growing in tropical and having high importance in food security and economy of the country. The study was conducted main season during first week of May to third week of September 2018 in the research field of Gokuleshwor Agriculture and Animal Science College, Baitadi of Sudurpaschim province in 3 replications in Randomized Complete Block Design with 13 local genotypes including 2 improved checks Black rice (G-60) and Sukkha Dhan-3 to evaluate performance of different local rice varieties grown in Gokuleshwor agro-environment. Phenotypic traits like plant height, tiller number, panicle number, panicle length, leaf area index and genotypic traits like thousands kernel weight, grain/panicle, productivity, biological yield and harvest index were the traits evaluated Highest grain yielding genotype was Naka Dhan (7.80ton/ha) and highest thousands kernel weight was found in Chiude (30.33 gm) . Phenotypic coefficient of variation was highest for number of unfilled grains per spike (81.39) followed by leaf area (51.37 cm^2) and lowest magnitude was exhibited by number of spike/panicle (26.16) and harvest index (19.44%). The heritability was highest for thousands kernel weight (99.07%) followed by plant height (95.23%) and panicle length (76.34%) and lowest for unfilled grains/spike (41.69%) and yield (41.36%). Correlation study suggested that productivity showed the positive significant association with biological yield (0.896) and harvest index (0.348). Most of other traits have shown positive association with productivity. Thus, Chiude and Naka dhan genotypes could further be used for breeding programmes for the environmental condition of Baitadi district, Nepal.

Keywords: Correlation, heritability, landrace, panicle, plant height, phenotypic traits.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the major stable cereal crops feeding more than 3.5 billion people worldwide (IRRI, 2017). A total of 49% calories consumed by the human population come from rice, wheat and maize of which 23% contributed by rice, 17% by wheat and 9% by maize. Thus, almost one fourth of the calories consumed by the entire world population come from rice (*Subudhi, et al., 2006*). Besides, rice also plays an important role

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both economically and in terms of food security (*Timmer, 2010*). Its annual Rice production in world was 741.4 million ton with the yield of 4.55 t/ha (FAO, 2017). In Asia, about 90% of global rice is produced and consumed (IRRI, 2013). Rice ranks first important staple crop of Nepal followed b y maize, wheat, millet and barley. It accounts for one-fifth of total agricultural GDP of the country. Nepal is rich in rice genetic resources with 1700 rice landraces growing from 60 to 3050 masl attitude (MOAC, 2010). Rice production, production area and productivity in Nepal during fiscal year 2074/75 B.S. was 5.15 million metric ton(mt), 1.47 million hacter(ha) and 3.51 t/ha (MOALD, 2076 B.S.).

Landraces are generally named by farmers based on their phenotype and genotypic traits and sometimes it is named by the location of production area. In general these nomenclature is imperfect as different name can be given to genetically closely related populations, while the same name can be given to genetically distinct ones. However, farmers have recognized, controlled acted and have developed own descriptors of the landraces. Highly increase in cultivation of hybrid seed causes losses of landrace varieties. However, the cultivation of the landraces is shaped in part by the production environment and by the cultural and religious significance (*Joshi and Bauer*, 2006). The average area share of landraces is slightly over 10% in Nepal. By season, this accounts 10.3% during main and 8.8% during early season. The popular landraces grown in Far-West area are Kaljade, Jhimi, Thapa chini, Chiude etc. Likewise Basmati, Kalanamak, Chanamchur, Sathiya etc are the landraces cultivated in eastern terai (*Crop Development Directorate*, 2015).

Highly use of hybrid seed, food insecurity, no use of landraces in breeding program and loss of genetic diversity are the rational to study. The major objective of this research is to study genetic variability of local rice genotype in *Gokuleshwor,* Baitadi.

MATERIALS AND METHOD

This research was conducted in irrigated agronomical farm of Gokuleshwor Agriculture and Animal Science College (GAASC), Gokuleshwor Baitadi (80034'E and 29040' N). It is situated in Far-Western state (state no.7) in *Dilasaini* rural municipality of Baitadi district. The elevation of research area is 811 masl. During the research period, maximum temperature was 32 ^{0}C and average temperature was 26 ^{0} C with an average rainfall of 130mm. The experiment was carried out during first week of May to third week of September, 2018. The experimental material consisted of 13 landraces rice genotypes including 2 improved genotypes (Table 1).

Table 1: Genotypes used in research study

Genotypes	Collected Area	Collected Height
Kaljade	Dilasaini, Baitadi	811 masl
Rato Basmati	Dilasaini, Baitadi	**811 masl**
Jhimi Dhan	Dilasaini, Baitadi	**811 masl**
Shyam Jeera	Dilasaini, Baitadi	811 masl
Oskote	Dilasaini, Baitadi	811 masl
Chiude	Dilasaini, Baitadi	811 masl
Temase Dhan	Dilasaini, Baitadi	811 masl
Naka Dhan	Dilasaini, Baitadi	811 masl
Sunaulo Dhan	Dilasaini, Baitadi	811 masl
Chhoro Dhan	Dilasaini, Baitadi	811 masl
Thapa Chini Dhan	Dilasaini, Baitadi	811 masl
Black Rice(G-60)	Hardinath, Dhanusa	75 masl
Sukkha Dhan-3	Khajura, Banke	146 masl

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The plot size was (1.2x1.6)m^2 with spacing of 0.5 m between experimental plots and 1m between replications. The crop geometry of rice was maintained at 20cmx20cm. The cultural operation like seed sowing, land preparation, fertilizer application, transplanting, weeding, harvesting were done as per recommendation of production. Observation of phenotypic traits was taken on 5 randomly selected sample plants escaping the boarder rows of individual plots. Observation was taken through biometric technique includes plant height, panicle number, panicle length, leaf area index, number of spike/panicle, number of filled grain/spike, number of unfilled grain/spike, productivity, biological yield, harvest index. The measured data were processed on R stat and correlation study, Phenotypic Co-officient of Variance(PCV), Genetic Co-officient of Variance(GCV), heritability, Genetic Advance Mean (GAM)calculation was done by using ms excel 2007.

RESULTS AND DISCUSSION

The genotypes were studied for under phonotypic traits, yield and yield attributing traits on the experimental field of GAASC.

PHENOTYPIC TRAITS

Quantitative phenotypic traits such as plant height, number of tiller, leaf area index, panicle number, panicle length were taken and evaluated genotypes under study. There was observed a significant difference and it is tabulated below Table.2:

Table 2: Performance of different rice genotypes for various phonological traits.

Genotypes	Plant height(cm)	Tiller/ Plant	Panicle/ Plant	Panicle length(cm)	Area(cm^2)
Kaljade	102.87^{bc}	17^{b}	12^{abc}	19.67^{ab}	28.39^{abcd}
Rato Basmati	111.93^{abc}	18^{b}	13^{ab}	18.00^{b}	34.48^{abc}
Jhimi dhan	104.60^{abc}	20^{ab}	11^{abc}	20.17^{ab}	34.60^{abc}
Shyam jeera	109.80^{abc}	24^{a}	16^{a}	22.00^{a}	34.03^{abc}
Oskote dhan	117.6^{a}	19^{ab}	12^{abc}	22.05^{a}	43.79^{a}
Chiude	75.33^{d}	14^{b}	7^{c}	22.61^{a}	13.48^{d}
Temase dhan	98.67^{c}	17^{b}	9^{bc}	20.92^{ab}	30.63^{abc}
Naka dhan	107.33^{abc}	19^{ab}	12^{abc}	20.37^{ab}	26.53^{bcd}
Sunaulo dhan	114.60^{ab}	16^{b}	9^{bc}	21.57^{ab}	40.74^{ab}
Chhoro dhan	83.93^{d}	19^{ab}	10^{bc}	21.25^{ab}	26.83^{bcd}
Thapachini dhan	101.13^{c}	20^{ab}	13^{ab}	20.67^{ab}	24.98^{bcd}
Black rice (G-60)	54.93^{e}	14^{b}	8^{bc}	14.39^{c}	22.91^{cd}
Sukkha Dhan -3	104.93^{abc}	19^{ab}	13^{ab}	19.60^{ab}	38.31^{abc}
Mean	99.00513	18	11	20.25	30.74
CV %	6.997823	15.16	26.62	9.74	28.14
LSD	5.66	2.48	2.34	2.59	7.06
F test @5%	***	*	*	**	*

Significant traits are denoted * for $p<0.05$, ** for $p<0.01$, *** and for $p<0.001$.

Rice genotypes had highly significant ($p<0.001$) difference on plant height which ranged from 54.93 cm to 117.6 cm (Table-2). Significantly, highest plant height was found on *Oskote Dhan* (117.6 cm), followed by *Sunaulo Dhan* (114.60 cm) and Rato Basmati (111.93 cm), while the lowest height was observed in Black rice(G-60) (54.93 cm). The average plant height was found to be 99.01 cm.(*Ranawake*, 2013). Likewise, genotypes had significant ($p<0.05$) effect on tiller/ plant ranges from 14 to 24 (Table-2). Significantly, highest tiller/plant was found on *Shyam Jeera* (24), followed by *Thapa Chini* and *Jhimi dhan* (20) and Sukhkha-3 (19). While the lowest tiller/plant was observed in *Chiude* (14). The average tiller/plant was found to be 18. Rice genotypes had significant ($p<0.05$) effect on panicle/plant ranges from 7 to 16 (Table-2). Highest panicle/plant was found on *Shyam jeera* (16) and lowest found on *Chiude* (7). The average panicle/plant was found to be 11. Number of reproductive tiller provide useful information for the rice breeders and

those characters have direct effect on yield per plant (*Sadeghi*, 2011). Rice genotypes had significant ($p<0.01$) effect on panicle length ranges from 14.39 cm to 22.61 cm (Table-2). Significantly, highest panicle length was found on *Chiude* (22.61 cm) followed by *Oskote dhan* (22.05 cm) and *Syam jeera* (22.00 cm). While the lowest panicle length was observed on Black rice (G-60) (14.39 cm). The average panicle length was found to be 20.25 cm. Panicle length also yield attributing characters (*Beser and Genctan*,1999) as an effect of plantation technique.The effect of rice genotypes had significant ($p<0.05$) effect on leaf area index ranges from 13.48 cm^2 to 43.79 cm^2(Table-2). Highest leaf area index was observed on *Oskote dhan* (43.79 cm^2) and lowest found on *Chiude* (13.48cm^2). The average leaf area index was found to be 30.74 cm^2.

YIELD AND YIELD CONTRIBUTING ATTRIBUTES

The yield and yield attributing characters obtained is shown in Table-3.

Table 3: Performance of yield attributing traits of different rice genotypes at Gokuleshwor, Baitadi.

Genotypes	NOS/P	NOG/S	NOUG/S	NOFG/P	TKW(gm)	Yield(t/ha)	Biological yield (t/ha)	Harvest index (%)
Kaljade Rato Basmati	10^{ab}	22^{a}	1^{b}	202^{a}	17.67^{e}	7.76^{a}	16.50^{a}	47.13^{a}
Jhimi Dhan	11^{ab}	14^{abc}	3^{ab}	121^{bcd}	17.33^{e}	5.68^{a}	15.83^{ab}	35.84^{b}
Syam jeera	10^{ab}	21^{ab}	2^{ab}	183^{abc}	15.00^{f}	5.90^{a}	15.29^{ab}	39.06^{ab}
Oskote Dhan	12^{a}	19^{abc}	3^{ab}	203^{a}	14.33^{f}	7.09^{a}	16.58^{a}	42.58^{ab}
Chiude	13^{a}	14^{abc}	3^{ab}	104^{cd}	22.67^{c}	5.29^{a}	11.18^{ab}	46.70^{ab}
Temase Dhan	9^{b}	13^{bc}	3^{ab}	85^{d}	30.33^{a}	4.81^{a}	10.29^{ab}	47.21^{ab}
Naka dhan	10^{ab}	15^{abc}	4^{ab}	112^{cd}	22.00^{cd}	4.86^{a}	12.33^{ab}	39.11^{ab}
Sunaulo Dhan	10^{ab}	20^{abc}	2^{ab}	178^{abc}	25.00^{b}	7.80^{a}	15.98^{ab}	48.67^{a}
Chhoro Dhan	10^{ab}	13^{bc}	2^{ab}	104^{cd}	25.00^{b}	5.67^{a}	13.51^{ab}	43.17^{ab}
Thapa Chini Dhan	11^{ab}	13^{bc}	5^{a}	78^{d}	26.33^{b}	4.89^{a}	10.73^{ab}	44.44^{ab}
Black Rice(G-60)	11^{ab}	12^{c}	4^{ab}	80^{d}	26.00^{b}	6.17^{a}	12.57^{ab}	49.36^{a}
	10^{ab}	15^{abc}	3^{ab}	119^{bcd}	26.00^{b}	4.53^{a}	9.54^{b}	48.10^{a}

Sukhkha Dhan-3	13[a]	20[abc]	2[ab]	192[ab]	20.67[d]	7.38[a]	17.00[a]	42.59[ab]
Mean	11	16	3	136	22.18	5.99	13.64	44.07
CV%	17.12	27.04	62.08	31.18	3.69	33.04	25.56	12.77
LSD	1.51	3.55	1.48	34.51	0.67	1.61	2.85	21.15
F-test@5%	NS	.	NS	**	***	NS	*	NS

Significant traits are denoted * for p<0.05, ** for p<0.01, *** for p<0.001 and NS for Non significant.

NOS/P for number of spike/panicle, NOG/S for number of grain/spike. NOUG/S for number of unfilled grain/spike, NOFG/P for number of filled grain/panicle and TKW for thousands kernel weight.

The effect of rice genotypes had non significant effect on number of spike/panicle which ranged from 9 to 13(Table 3) highest number was observed on *Oskote dhan* (13). While the lowest number was observed in *Chiude* (9). The average number was found to be 11. The number and development of spikelets on a panicle directly affect the grain yield (*Beser and Genctan*, 1999). Rice genotypes had non significant effect on number of grain/ spike ranges from 12 to 22 (table 3). Highest number was observed on *Kaljade* (22). While the lowest number was found on *Thapa chini dhan* (12). The average number to be 16.The effect of rice genotypes had non significant effect on number of unfilled grain / spike ranges from 1 to 5 (table 3). Highest number was found on *Chhoro dhan* (5) and lowest number was found on *Kaljade* (1). The average number was found to be 3.The effect of rice genotypes had significant (p< 0.01) effect on number of filled grain/ panicle ranges from 78 to 203 (table 3). Highest number was found on *shyam jeera* (203) and lowest number number was found on *Chhoro dhan* (78). The average number was found to be 136.The effect of rice genotypes had highly significant (p< 0.001) effect on thousand kernel weight ranges from 14.33 to 30.33 gram (table 3). Highest TKW was found to be on *Chidue* (30.33) and lowest TKW was found to be on *Shyam jeera* (14.33). The average weight was found to be 22.18 gram.The effect of rice genotypes had non significant effect on yield ranges from 4.53 t/ha to 7.80 t/ha (table 3). Highest yield was found on *Naka dhan* (7.80 t/ha) followed by *Kaljade* (7.76 t/ha) and Sukkha-3 (7.38 t/ha). While the lowest yield was found on Black rice (G-60) (4.53 ton/ha). The average yield was found to be 5.99 t/ha.Rice genotypes had significant (p<0.05) effect on biological yield ranges from 9.54 to 17.00 t/ha (table 3). Highest yield was found on Sukhha-3 (17.00 t/ha) and lowest yield was found on Blackrice (G 60) (9.54 t/ha). The average biological yield was found to be 13.64 t/ha.The effect of rice genotypes had non significant effect on harvest index ranges from 35.84% to 49.36% (table 3). Highest harvest index was found on *Thapa chini dhan* (49.36%) and lowest was found on to be *Rato basmati* (35.84%). The average harvest index was found to be 44.07%.

CORRELATION STUDY:

The correlation study among different traits are shown in table.

Table 4: Relation among different traits.

	PH	Tiller no.	Panicle No.	Panicle length	Leaf area	NOS/P	NOG/S	NOFG/S	NOUG/S	NOFG/P	TKW	productivity	BY	HI
PH	1	.428**	.472**	.353*	.504**	.251	.212	.258	-.160	.213	-.503**	.343*	.443**	-.181
Tiller no.		1	.747**	.068	.349*	.322*	.268	.258	.001	.335*	-.447*	.513**	.544**	-.019
Panicle no.			1	.118	.429**	.056**	.358*	.303	.110	.333**	-.518**	.744**	.720**	.122
Panicle Length				1	.252	.127	-.095	-.112	.066	-.087	.027	.060	.041	.033
NOS/P					1	.159	.147	.045	.434**	-.237	.283	.251	.111	
NOG/S						1	.935**	-.002	.824**	-.463**	.588**	.543**	.163	
NOFG/S							1	-.354*	.863**	-.504**	.567**	.512**	.194	
NOUG/S								1	-.276	.219	-.044	-.011	-.112	
NOFG/P									1	-.576**	.597**	.566**	.154	
TKW										1	-.274	-.483**	.389*	
Productivity											1	.896**	.348*	
BY												1	-.092	
HI													1	

The result on correlation study suggested that plant height showed the positive significant association with tiller number (.428**), panicle number (.472**), panicle length (.353*), leaf area (.504**), productivity (.343*), biological yield (.443**) and positive association with number of spike./ panicle (.251), number of grain / spike (.212), number of filled grain/ spike (.258), number of filled grain / panicle (.213). the negative significant association with TKW (-.503**) and negative association with number of unfilled grain/ spike (-.160), harvest index (-.181). However, it has been reported that plant height was affected by many factors like plantation method, plant density and fertilizer application (Beser and Gentan,1999; Aide and Beighly, 2006; Gozubenli,1992).Tiller number had positive significant association with panicle number (.747**), leaf area (.349*), number of spike / panicle (.322*), number of filled grain / panicle (.335*), productivity (.513**), biological yield (.544**) and positive association with panicle length (.0680),

number of grain / spike (.268), number of filled grain / spike (.258), number of unfilled grain / spike (.001). The negative significant association with TKW (-.447**) and negative association with harvest index (-.019).Panicle number had positive significant association with leaf area (.429**), number of spike/ panicle (.506**), number of grain / spike (.358*), number of filled grain / panicle (.444**), productivity (.744**), biological yield(.720**) and positive association with panicle length (.118), number of filled grain / spike (.303), number of unfilled grain/ spike (.101), harvest index (.122) . The negative significant association with (-.518**).Panicle length had positive association with leaf area (.252), number of spike / panicle (.127), number of unfilled grain / spike (.066) , TKW (.027), productivity (.060), biological yield (.041), harvest index (.033). The negative association with number of grain / spike (-.095), number of filled grain / spike (-.112), number of filled grain / panicle (-.087). However, Ulger and Genc (1989), Beser and Genctan (2001), Surek (2002) and Ghosh *et al.*, (2004) reported that the tiller number and grain number per panicle were affected by the environmental and cultivation factors as well.Gozubenli(1992) reported that the grain weight per panicle was affected by the rate of fertilizer and plant density.Leaf area had positive significant association with number of spike / panicle (.321**), biological yield (.419**) and positive association with number of grain/ spike (.147), number of filled grain / spike (.137), number of unfilled grain/ spike (.024), number of filled grain/ panicle (.121), productivity (.281). The negative significant association with TKW (-.398*) and negative association with harvest index (-.238).Number of spike/ panicle had positive significant association with number of filed grain /panicle (.434**) and positive association with number of grain/ spike (.1590, number of filled grain / spike (.147), number of unfilled grain/ spike (.045), productivity (.283), biological yield (.251), harvest index (.111). The negative association with TKW(-.237).Number of grain / spike had positive significant association with number of filled grain/ spike (.935**), number of filled grain/ Panicle (.824**), productivity(.588**), biological yield (.543**) and positive association with harvest index (.163). The negative significant association with TKW (.463**) and negative association with number of unfilled grain/spike (-.002). Number of field grain / spike had positive significant association with number of filled grain/ panicle (.863**), productivity (.567**), biological yield (.512**) and positive association with harvest index (.194). The negative significant association with number of unfilled grain with panicle (-.354*), TKW (-.504**). Number of unfilled grain/ panicle had positive association with TKW (.219). Negative association with number of filled grain with panicle (-.276), productivity (-.044), biological yield (-.011), harvest index (-.112). Number of filled grain with panicle had positive significant association with productivity (.597**), biological yield (.566**) and positive association with harvest index (.154). The negative significant association with TKW (-.576**). TKW had positive significant

association with harvest index (.389*). The negative significant association with (-.483**) and negative association with productivity (-.274).According to Surek and Beser (1996) and Manzoor *et al.*, (2006), 1000 g weight was affected by cultivation methods. However, Aidei and Beighly (2006) reported that cultivation methods didn't have such effect on 1000-grain weight.Productivity had positive significant association with biological yield (.896**), harvest index (.348*).Biological yield had negative association with harvest index (-.092).

PHENOTYPIC GENOTYPIC COFFICIENT OF VARIATION

The value for phenotypic variance were higher than those of genotypic variance for all traits. The relative magnitudes of the phenotypic as well as genotypic variance between the traits were compared based on phenotypic and genotypic coefficient of variation.Phenotypic coefficient of variation highest for number of unfilled grain per spike (81.39117) followed by leaf area (51.37263), panicle number (45.75641). Lowest magnitude of phenotypic coefficient of variation exhibited by harvest index (19.4426) followed by number of spike per panicle (26.16054). The results are in accordance with the findings of other researchers (Bai and Tran, 1991; Chaubey and Singh, 1994. The difference of PCV and GCV is lower forthousands kernel weight, plant height and panicle length which shows there is lower environmental effect. Similarly, difference is high for number of unfilled grain per spike, yield and number of grain per spike. Similar result was observed by Anjaneyulu, Reddy(2010), Mahato, Yadav and Mohan (2009), Singh, Kumar and Machhavi Latha (2007) studied on 50 germplasm on line of rice and reported high PCV and GCV values for number of grains per panicle.

HERITABILITY

The estimation for heritability for different traits under study are presented in the table. The heritability ranged from 99.07% to 41.36%. The heritability was highest for thousands kernel weight (99.07%) followed by plant height (95.23%) and panicle length (76.34%). Lowest heritability was for number of unfilled grain per spike (41.69%) and yield (41.36%). Similar results were observed by Saravanan and Senthil for days to 50% flowering, plant height, and test weight (Ali *et al.*, 2000).

GENETIC ADVANCE

Estimates of genetic advance as percentage of mean was highest for thousands kernel weight (78.37) followed by leaf area (74.09). Lowest were observed for harvest bindex (22.74). Similar result were observed by Sabesan *et al.* (2009) for grain yield per plant, test weight and number of tiller.

Table 5: variability parameters for different quantitative traits among 13 genotypes of rice on may-sep, 2018 at Gokuleshwor, Baitadi

Traits	Gcv	pcv	H	GA	GAM
Plant height	31.26101	32.03467	0.952282	62.217113	62.844241
Tiller no.	23.9706	29.48421	0.660966	7.109746	40.14538
Panicle no.	37.2113	45.75641	0.661372	6.713367	62.33974
Panicle length	17.50265	20.03168	0.763436	6.378177	31.50339
Leaf area	42.98634	51.37263	0.70016	22.78091	74.0963
NOS/P	19.78047	26.16054	0.571715	3.325646	30.81014
NOG/S	35.39651	44.5447	0.631435	9.314725	57.94181
NOUG/S	52.55855	81.39117	0.416996	2.041547	69.916
TKW	38.22274	38.4005	0.990763	17.38265	78.37435
Yield	27.75712	43.15809	0.413642	2.203196	36.7751
Biological yield	30.71354	39.9621	0.590695	6.635175	48.62715
Harvest index	14.65263	19.4426	0.567966	10.02688	22.74804

High heritability and high genetic advance attributed to additive gene action. Khan (1990) suggested that high genetic advance and high heritability may be due to mainly additive gene action and under the circumstance advocated simple plant.

CONCLUSION

The thousands grain weight has highest on Chiude and highest yield on *Naka dhan*: yield is non significant and positively correlated with plant height, panicle length and harvest index. The traits thousands grain weight, plant height, panicle length shows lowest difference of PCV& GCV and has highest GAM. Thus, *Chiude* and *Naka dhan* genotypes can further be used for breeding programmes in the environmental condition for Baitadi district.

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