Global Scientific JOURNALS
GSJ: Volume 8, Issue 2, February 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

DIVERSITY ASSESSMENT OF RICE (*Oryza sativa* L) LANDRACES ADOPTED TO TERAI, NEPAL

S. Poudel*, A. Poudel, S. Poudel, S. Neupane and N. Bhandari

Institute of Agriculture and Animal Science, Lamjung Campus

**samirpoudel09@gmail.com*

ABSTRACT

Rice landraces provide opportunities to develop and to improve the genotypes. The large scale spread of modern, high yielding varieties has replaced the traditional varieties leading to reduced genetic base and increased genetic vulnerability and erosion. The objective of the study was to assess characters, diversity and determine the correlation among the yield and yield attributing agro-morphological traits. Twenty eight landraces of rice collected from terai region of Nepal were characterized in AFU, Rampur, Chitwan, during rainy season of 2018. The experiment was conducted under rod row matrix design. 10 quantitative and 12 qualitative characters were recorded.Maximum variability was seen in culm lodging resistance, auricle colour, lemma colour of apiculus while minimum variability was recorded in basal leaf anthocyanin coloration and culm underlying internode coloration. The correlation study showed grain yield was positively and significantly correlated with number of filled grains per panicle, thickness of seed and 1000 grain weight while it was found positively correlated with panicle length and length of seeds. Also, grain yield was found to be negatively correlated with culm number, panicle number and number of unfilled grains per panicle. For cluster analysis, landraces were grouped into four clusters and the inter-cluster values ranged from 170.29 to 706.183 which indicate wide range of diversity between the landraces. Shannon index was ranged from 1.41 to 0.41 while evenness ranged from 0.475 to 0.959. Results suggested that the number of filled grains per panicle, thickness of seed and 1000 grain weight should be considered for the selection than other traits for yield breeding programme.

Key words: base, erosion, improvement, matrix, vulnerability.

1. INTRODUCTION

Rice (*Oryza sativa L.*) is one of the most important staple food crops grown worldwide. India is the leading one in production, followed by china, Indonesia and Bangladesh (FAOSTAT, 2017). The genus, *Oryza*consists of 2 cultivated species and more than 20 wild species. The cultivated species are *Oryza sativa* and *Oryzaglaberrimma* grown worldwide and in west Africa respectively. The sativa species are grouped into three sub species, namely Indica, Japonica and Javanica.Nepal, being a country with different agro-ecological climatic zones several wild species (*Oryzarufipogon, O. nivara, O. granulata, O. sativa varspontanea, O. officinalis, H. aristata and L. hexandra*) and thousands of landraces of rice were locally developed and domesticated over time through adaptation to its environment of agriculture (Joshi et al., 2008). Along with the typical characters, landraces also have potential to adapt

to stressful environment such as water stress, salinity and high temperature. Landraces are the greater source of different characters for improvements of variety through different breeding efforts which results in higher productivity (Tang, Jiang, Li, and Yv, 2002). Assessment of genetic diversity is very important in rice breeding from the view point of conservation of different landraces in crop improvement programs (Patra, 2000).The modern high yielding varieties which are the back bone of green revolution have caused the erosion of landraces (Fowler and Mooney, 1990).Terai region of Nepal is booned with diversified soil and climatic conditions with the largest germplasm/landraces collection which supports the breeding programme for the development of varieties possessing the positive attributes. In order to design breeding programmes there is need to know the genetic diversity among the landraces and their characters.
The objective of this research was to analyze the genetic diversity of landraces of Rice. The main aim was to calculate Shannon diversity index and evenness and to study the genetic divergence in rice landraces through multivariate analysis.

2. MATERIALS AND METHODOLOGY

The experiment was carried out during rainy season of 2018 at AFU Rampur, Chitwan, Nepal. The place is located at sub-tropical climate. Twenty eight types of varieties were used. Thenet plot size 2mx1m= $2m^2$.For the experiment genotypes were laid out in rod row matrix design.38 DAS, seedlings were transplanted using 2-3 seedlings/hill in a given plant geometry on 2075/04/15.The seedling were transplanted in the prepared field with 20*20 cm^2 spacing. Harvesting was done manually with help of serrated sickle. Plot wise harvesting was done from the plot. After harvesting, threshing was done manually.

2.1. Recording of observations

Twenty two characters which include 9 quantitative and 12 qualitative characters were recorded as per the descriptor provided by the IRRI. The details of the observations and the techniques adopted to collect data in each parameter are rendered below:

I. Qualitative Characters:

Qualitative characters were recorded through visual observations on randomly selected plants in each plot at proper growth stages on twelve qualitative characters viz., basal leaf sheath color, leaf blade intensity of green color, basal leaf anthocyanin coloration, leaf sheath anthocyanin, leaf blade surface, auricle color, collar color, lemma color of apiculus, panicle exsertion, culm underlying internode coloration, culm lodging resistance and panicle attitude of branches.

II. Quantitative Characters:

Data on nine parameters were collected from five randomly selected plants in each plot. The yield and yield attributing characters culm number, panicle number, panicle length, number of filled grains per panicle, number of unfilled grains per panicle, length of seed, thickness of seed and 1000 seed weight were measured as per the standard techniques and the mean of five plants for all the characters was used for carrying statistical analysis.

Data analysis:
Data analysis and recording was done using MS-Excel, R-studio version 3.1.1, MINITAB and SPSS version 16.

Table 1: Treatment details

Plot no.	Name of Landraces	Location	Plot no.	Name of Landraces	Location
1	Parewapakh	Bara	15	Ratobachhi	Jhapa
2	Ratotudeseto basmati	Bara	16	Malbhog	Bara
3	Pulingtar	Jhapa	17	Tilki	Jhapa
4	Komaldhan	Jhapa	18	Samalchauri	Jhapa
5	Kusumkali	Bara	19	Karma	Bara
6	Pakha	Bara	20	Siladar	Bara
7	Thapachini	Dang	21	Saauthyaari	Jhapa
8	Chhayang	Nawalparasi	22	Nimalo	Bara
9	Kesarbachi	Bara	23	Calkajesariya	Bara
10	KaloTulasi	Bara	24	Malathe Ate	Bara
11	Lajhi	Bara	25	Thulomansara	Jhapa
12	Kaniyaparewapdkha	Bara	26	Meethai	Nawalparasi
13	Rangadhan	Jhapa	27	Madhumala	Bara
14	Rajala	Bara	28	Seto dale	Bara

3. RESULTS AND DISCUSSION

3.1. Quantitative Analysis

3.1.1Correlation Analysis

Table no 2. Pearson correlation matrix of 9 quantitative characters used in characterization of landraces of rice

	CN	PN	PL	NFG	NuFG	LS	TS	TSW	TSY
CN	1								
PN	.910**	1							
PL	-0.096	-0.101	1						
NFG	-0.078	-0.086	.477*	1					
NuFG	0.04	0.049	.453*	0.237	1				
LS	-0.07	-0.095	0.09	-0.176	-0.202	1			
TS	-0.251	-0.231	0.192	0.32	0.17	0.033	1		
TSW	-0.101	-0.191	0.137	0.199	-0.183	.436*	.508**	1	
TSY	-0.145	-0.229	0.187	.504**	-0.065	0.066	.412*	.598**	1

**Sig. at 1 percent level of significance
* Sig. at 5 percent level of significance
*CN – Culm number; PN – Panicle number; PL- Panicle length; NFG – Number of filled grains per panicle; NuFG- Number of unfilled grains per panicle; LS- Length of seed; TS- Thickness of seed; TSW- Thousand seed weight; TSY- Total seed yield.

Correlation among the traits

Panicle number is positively and significantly correlated with culm number (.910**). It is negatively and non-significantly correlated with culm number (-0.096). It is negatively and non-significantly correlated with panicle number (-0.101).Number of filled grains per panicle is negatively and non-significantly correlated with culm number (-0.078) and panicle number (-0.086). NFG/P is positively and significantly correlated with panicle length (0.477*).Number of unfilled grains per panicle is positively and non-significantly correlated with culm number (0.04), panicle number (0.049) and with number of filled grains (0.237). NuFG/P is positively and significantly correlated with panicle length (.453*). Length of seed is negatively but non significantly correlated with culm number (-0.07), panicle number(-0.095), number of filled grains per panicle (-0.176) and number of unfilled grains per panicle (-0.202). Length of seed is positively and non-significantly correlated with panicle length (0.09).Thickness of seed is positively but non significantly correlated with panicle length (0.192), number of filled grains per panicle (0.32), number of unfilled grains per panicle (0.17) and length of seed (0.033). TOS is negatively but non significantly correlated with culm number (-0.251) and panicle number (-0.231). It is considered as a yield-attributing trait (Khare et al., 2014), 1000 grain weight is negatively but non-significantly correlated with culm number (-0.101), panicle number (-0.191) and number of unfilled grains per panicle (-0.183).1000 grain weight is positively and non-significantly correlated with panicle length(0.137), and number of filled grains per panicle(0.199). 1000 grain weight is positively and significantly correlated with seed length (0 .436*) and thickness of seed (0.508*).

Grain yield

The result from the experiment was that the grain yield is positively and significantly correlated with number of filled grains per panicle (0.504**), thickness of seed (0.412*) and 1000 grain weight (0.598**) while it was found positively and non-significantly correlated with panicle length (0.187) and length of seeds (0.066). Also, grain yield was found to be negatively and non-significantly correlated with culm number (-0.145), panicle number (-0.229) and number of unfilled grains per panicle (-0.065). Rice grain yield has been found to be positively correlated with number of filled grains per panicle and 1000-grain weight (Geethaet al., 1994; Samonte et al. 1998).

3.1.2. Cluster analysis

The clustering of rice landraces based on quantitative characters like culm number, panicle number, panicle length, number of filled grain, number of unfilled grain, length of seed thickness of seed, and 100 seed weight and grain yield presented in Figures. Based on the similarity percentage and related characters four clusters were constructed. Most closely related landraces were 9 and 10 with similarity 99.30% and most distantly related accessions were 1 and 17 with similarity 32.17%. The maximum numbers of 17 varieties were included in the cluster III and the minimum number of 1 variety included in the cluster IV. Cluster I and II consist of 2 and 8varieties respectively. Clustering of landraces of same region into different clusters revealed wide genetic base (Shanmugam and Rangasamy, 1982).The inter cluster distance was maximum in between cluster III and IV (706.033) and minimum in between cluster I and IV (170.466). Hence the genotypes of cluster III is more divergent then the cluster IV in comparison between cluster I and cluster II. The range of inter-cluster values ranged from 170.29 to 706.183 indicates wide range of diversity. Medium cluster distance were observed for cluster I and cluster II (277.480), I and cluster III(536.940), cluster II and cluster III (260.344) and between cluster II and cluster IV (447.389). As cluster I possess the highest value for culm length (116.7), number of filled grains per panicle (155.3), weight of

1000 seed weight (26.70) and had the better result than grand centroid value in, culm number (9.5), panicle number (7.5), panicle length (23.05), length of seed (8.222), and thickness of seed (3.119) but lower value in number of filled grains per panicle (34.2). Keeping this in view, it could be concluded that landraces from clusters I which include 7.15% of experimented variety may be used in breeding programme to generate high yielding varieties.

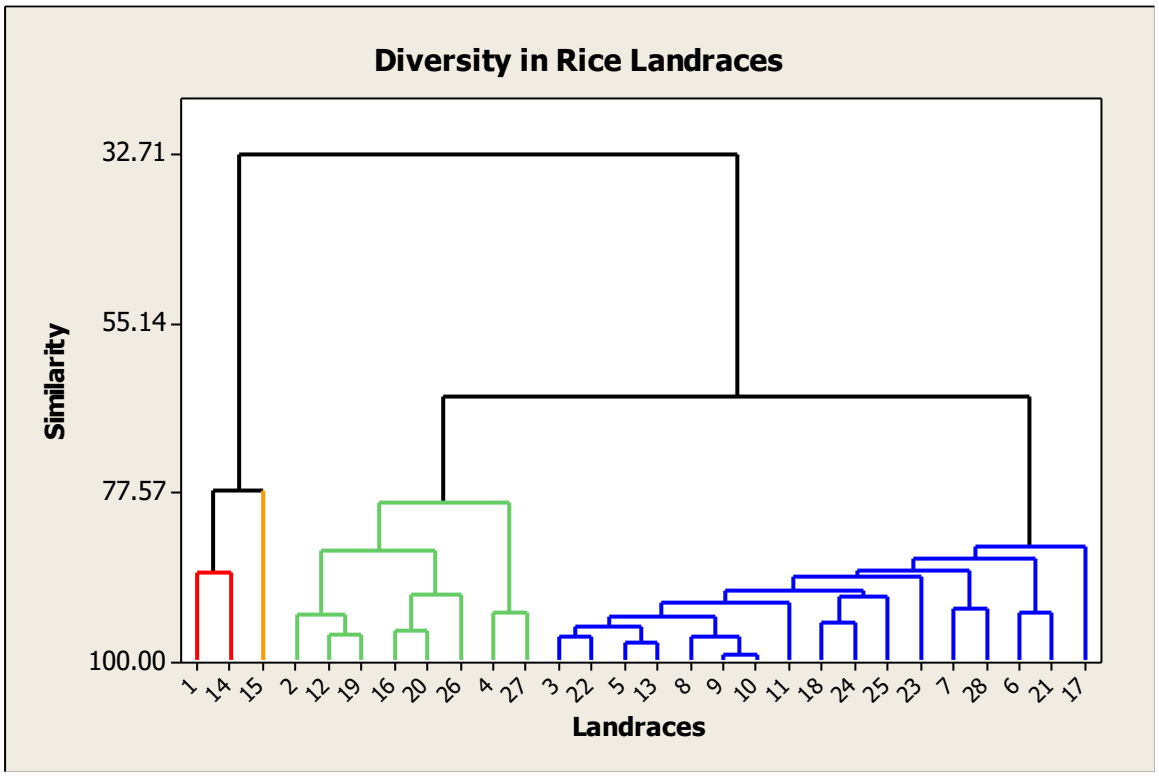

Figure no 1: Dendrogram showing diversity in 28 Nepalese rice landraces based on quantitative characters

Table no 3: Distance between four classes of 28 rice landraces

	Cluster1	Cluster2	Cluster3	Cluster4
Cluster1	0			
Cluster2	277.48	0		
Cluster3	536.94	260.344	0	
Cluster4	170.466	447.389	706.033	0

Table no 4: Cluster comparison with various traits

Variable	Cluster1	Cluster2	Cluster3	Cluster4	Centroid
CL	116.7	112.075	107.679	109.6	109.648
CN	9.5	8.525	9.6	8.8	9.257
PN	7.5	7.05	7.894	6.8	7.586
PL	23.05	23.71	22.812	26.6	23.221
NFG	155.3	144.7	106.024	148.8	122.121
NuFG	34.2	38.225	34.976	33.6	35.8
LS	8.222	8.098	7.914	8.266	8.001
TS	3.119	2.848	2.718	3.286	2.804
TSW	26.7	21.775	18.4	25.7	20.218
TSY	628.85	351.688	94.318	799	231.2

*CN – Culm number; PN – Panicle number; PL- Panicle length; NFG – Number of filled grains per panicle; NuFG- Number of unfilled grains per panicle; LS- Length of seed; TS- Thickness ofseed; 1000 SW- Thousand seed weight; TSY- Total seed yield

Table no 5. Distribution of 28 rice landraces in different clusters

Cluster (no of varieties)	Varieties
I (2)	Parewapakh, Rajala
II (8)	Ratotudeseto basmati, Komaldhan, Kaniyaparewapdkha, Malbhog, Karma, Siladar, Meethai, Madhumala
III (17)	Pulingtar, Kusumkali, Pakha, Thapachini, Chhayang, Kesarbachi, Kalotulasi, Lajhi, Rangadhan, Tilki, Samalchauri, Saauthyaari, Nimalo, Calkajesariya, Malathe ate, Thulomansara, Seto dale.
IV (1)	Ratobachhi

3.2 Qualitative Analysis

3.2.1 Shannon diversity index and evenness:

The diversity was analysed with the help of Shannon Wiener index. The maximum number of diversity was observed in lemma colour of apiculus (1.408) followed by panicle altitude of branching (1.329), culm lodging resistance (1.312), auricle colour (1.304) and leaf blade surface (1.051). The culm underlying internode coloration (0.41) followed by basal leaf anthocyanin coloration (0.469) were exhibits least diversified in trait found in landraces. The Shannon Weiner Diversity index for other traits is explained in the Table no 7. Shannon Wiener Index analysis revealed that a lot of diversity among the 28 landraces used in the experiment. Higher the value of Shannon index, more the diversity present in the characters. . Highest diversity was exhibited by the trait lemma colour of apiculus (1.408) followed by panicle altitude of branching (1.329). This means that the genotypes were most diversified in these traits. The culm underlying internode coloration (0.41) had the least diversity index, which means that the twenty eight genotypes were least diverse in case of their culm underlying internode coloration.

Along with this, evenness was also calculated and revealed that panicle attitude of branches (J=0.959) was even followed by leaf blade surface (J=0.957) and leaf blade intensity of green colour (0.887). Least evenness was found in trait of collar colour (J=0.475) followed by leaf sheath anthocyanin (J=0.578). The evenness of others traits can be studied from Table no 7. Evenness value gives the equality in the distribution of the traits in the population. Evenness value equal to one means even population i.e. the population are equally distributed. The twenty eight genotypes were highly even in some traits whereas they were observed to have unevenness in the distribution as well. Panicle attitude of branches had 0.949 i.e. the attitude compact, open, horizontal and drooping were equally distributed among the genotypes. The next trait having higher evenness value was found to be leaf blade surface (J=0.957) i.e. glabrous,pubescent, and intermediate are also evenly distributed.The trait which had least evenness was observed to be collar colour of the genotypes (J=0.475) which also had the lower diversity index (H).

The result revealed that there was a wide amount of diversity and less evenness in the distribution in the collected landraces in which the experiment was carried out. Therefore, it could be beneficial information for the selection of landraces in rice breeding programs and further exploration of genetic diversity.

3.2.2 Frequency Analysis

Table no 6: Frequency distribution of 28 landraces of rice for various qualitative characters

S.N	Characters	state of expression	number of varieties	frequency %	Eveness (J)	Shannon Wiener index (H')
1	Basal leaf sheath color	Green	19	67.9	0.684	0.948
		light purple	2	7.1		
		Purple	2	7.1		
		purple line	5	17.9		
2	Leaf blade intensity of green color	Dark	7	25.0	0.887	0.974
		light	5	17.9		
		Medium	16	57.1		
3	Basal leaf anthocyanin coloration	Absent	23	82.1	0.677	0.469
		Present	5	17.9		
4	Leaf sheath anthocyanin	Absent	21	75.0	0.578	0.801
		Medium	2	7.1		
		Strong	1	3.6		
		Weak	4	14.3		
5	Leaf blade surface	Glabrous	13	46.4	0.957	1.051
		Intermediate	9	32.1		
		Pubescent	6	21.4		
6	Auricle color	Absent	6	21.4	0.810	1.304
		light purple	1	3.6		
		purple line	1	3.6		

		Whitish	10	35.7		
		yellowish green	10	35.7		
7	Collar color	Absent	1	3.6	0.475	0.658
		Green	2	7.1		
		light green	23	82.1		
		Purple	2	7.1		
8	Lemma color of apiculus	Brown	2	7.1	0.875	1.408
		Green	13	46.4		
		Purple	4	14.3		
		purple apex	5	17.9		
		White	4	14.3		
9	Panicle exsertion	Exserted	2	7.1	0.698	0.968
		moderately-well exserted	8	28.6		
		well-exserted	17	60.7		
		partially exserted	1	3.6		
10	Culm underlying internode coloration	Green	24	85.7	0.592	0.41
		light gold	4	14.3		
11	Culm lodging resistance	Intermediate	3	10.7	0.815	1.312
		Strong	13	46.4		
		very strong	8	28.6		
		very weak	1	3.6		
		Weak	3	10.7		
12	Panicle attitude of branches	Drooping	7	25.0	0.959	1.329
		Horizontal	11	39.3		
		Open	5	17.9		
		semi-compact	5	17.9		

Qualitative characters are important tools to describe plant and affected by the consumers taste, socio-economic condition and natural selection (Das and Ghosh., 2011). Frequency distribution for 12 qualitative characters is shown in Table no 8 and its graphical representation of frequency distribution pictured in Figure no 6. Out of 12 qualitative characters observed 2/2 were dimorphic and trimorphic and remaining 8 showed more than 3 states of expression among the varieties. A majority of landraces were found to possess Basal leaf: sheath colour (67.9% green), Leaf blade colour (57% medium green), Basal leaf anthocyanin coloration (absent 82%), Leaf sheath anthocyanin (75% absent), Leaf blade Pubescence (46% glabrous), Auricle colour (36/36% whitish and yellowish green), Collar colour (82% light green), Lemma colour of apiculus (46% green), Panicle exsertion (61% well exserted),Culm node colour (86% green),Culm lodging resistance (46% strong) and Panicle attitude of branches (39% horizontal).Similar type of study was also performed by Bisne and Sarawgi (2008) and Pachauri et al (2017).

5. SUMMARY AND CONCLUSION

Correlation analysis revealed that the number of filled grains per panicle, thickness of seed and thousand grains weight were highly associated with grain yield and must be taken into account for selection. Regression analysis showed positive relationship between independent variables such as number of filled grains per panicle, thickness of seed and thousand grains weight, and dependent variable as total grain yield. It showed that variation in total grain yield per plot was caused due to number of filled grains per panicle by 25.43%, thickness of seed by 16.98% thousand grains weight by 35.8% and the remaining changes was caused by other unmapped factors.

Cluster analysis displayed considerable genotypic diversity and were grouped into four clusters. The maximum numbers of seventeen varieties were included in the cluster III having some similar characteristics followed by cluster II and I with eight and two genotypes respectively while cluster IV was mono genotypic. The inter cluster distance was maximum in between cluster III having and IV, revealed that there was broad genetic base. Therefore selection of parents can be made from these two clusters in breeding programs to produce wide variability.

Shannon diversity index (H') ranged from 0.41 to 1.408 which revealed that a lot of diversity among the 28 landraces used in the experiment. The greater the value, the greater will be the diversity. From the table, lemma color of apiculus was most diversified in twenty eight genotypes while least diversified trait was culm underlying internode coloration. Therefore selection of genotypes can be made on these widely diversified traits to produce wide variability and transgressive segregation with high heterotic effects. Along with this value of evenness ranged from 0.475 to 0.959. Evenness value equal to one means an even population i.e. the population are equally distributed. From the table, panicle attitude of branches was equally distributed among twenty eight genotypes.

The results from qualitative traits was that most of the experimented landraces had green basal leaf sheath color, medium intensity of leaf blade green color, glabrous leaf blade surface, whitish and yellowish auricle color, light green collar color, green lemma color of apiculus, green culm underlying internode coloration, horizontal attitude of panicle branches, strong culm lodging resistance and well-exserted type of panicle exsertion. The basal leaf anthocyanin coloration was present only in five landraces.Leaf sheath anthocyanin was absent in twenty one landraces.

REFERENCES

Bisne R. and A.K. Sarawgi. Morphological and quality characterization of Badsahbhog group from aromatic rice germplasm of Chhatisgarh. Bangladesh J Agric. Res. 2008; 33(4):479-492.

FAOSTAT, 2017.Available at http://www.faostat.fao.org.

Fowler, C.and P. R. Mooney. 1990. Shattering: food, politics, and the loss of genetic diversity: University of Arizona Press.

Geetha, S., A.P.M. KirubakaranSunderaraj, S. Giridharan, and B. Selvi. 1994. Association of component characters of medium duration rice genotypes. Annals of Agricultural Research 15:410-412.

Joshi, B.K., K.C., H.B., Upadhyay, M.P., Gupta, S.R., Lu, B.R., Mathur, P.N. and Sthapit, B.R., 2008. Ex-situ and in-situ management of wild and weedy rice in Nepal using a geographical information system. Plant Genetic Resources Newsletter, 2008, No. 155:69-74.

Pachauri AK, Sarawgi AK, Bhandarkar S, Ojha GC. Genetic variability and association study for yield contributing traits of promising core rice germplasm accessions (Oryzasativa L.) Res. on Crops. 2017; 18(1):133-138

Patra, B.C. 2000. Collection and characterization of rice genetic resources from Keonjhar district of Orissa. *Oryza*. 34:324-326.

Samonte, S.O.P., L.T. Wilson and A.M. McClung, 1998. Path analyses of yield-related traits of fifteen diverse rice genotypes. Crop Science 38:1130-1136.

Shanmugam, A.S. and Rangasamy, S.R.S. 1982. Genetic diversity for quantitative characters in greengram (Vigna radiate L.)Tahe Madras Agriculatural Journal, 76(12):631-636.

Tang, S., Y. Jiang, Z. Li, and H. J. Z. w. x. b. Yv. 2002. Genetic diversity of isozymes of cultivated rice in China. 28(2): 203-207.