RESEARCH ARTICLE

CHARACTERISING THE DIVERSITY OF RICE LANDRACES FOR EFFECTIVE CROP MANAGEMENT AT A REGIONAL SCALE WITH FARMERS' PARTICIPATION

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Abstract: Two hundred and two accessions of traditional landraces/varieties augmented from Andhra Pradesh, Odisha, Karnataka and Tamil Nadu states were characterized for 12 qualitative and 7 quantitative traits under natural farming/organic farming environment through a NGO network. The study revealed high degree of variation in agro-morphological traits of rice landraces with a Shannon diversity index ranging from 0.0136 to 0.5080. The coefficient of variation was more than 10% for majority of the quantitative traits studied, highest being total number of tillers (38.2%) followed by panicle length (22.8%). Promising accessions suiting to organic/natural farming ecosystems, effective crop management at regional level and donors for various economic traits that would fit into a sustainable cropping system model are discussed.

Keywords: Rice, Landrace, Characterization, Germplasm, Organic farming, Natural farming

INTRODUCTION

Rice (*Oryza sativa* L.) is an important crop of the Indian subcontinent and the staple food for its large population which is cultivated in almost all the 26 states and 7 Indian territories of India under various agroclimatic conditions (Nilamani Dikshit et al., 2014). The farmers of eastern, southern, central India grow traditional landraces of rice since time immemorial. The traditional indigenous varieties/landraces of crops of rainfed agriculture are well adapted and suited to local farming systems and confers increased resilience in production system. They are potential sources of traits for crop improvement, especially for developing varieties tolerant to biotic and abiotic stresses which are the farmer-preferred traits. Unfortunately, such genetic resources are replaced by modern cultivars in recent decades, leading to reduced number of varieties and homogeneity. Such losses make farming systems less resilient, especially to shocks from abiotic and biotic stresses. Many landraces disappeared from cultivation but are conserved in genebanks. The Indian National Gene Bank (NGB) located at New Delhi currently holds over 1, 16,300 accessions of rice germplasm (www.nbpgr.ernet.in) collected all over the country. In recent decade, several challenges confront the rice germplasm scenario in Indian subcontinent like the switching over from rice-based cropping system to diversified cropping system, crop failure due to erratic rain fall and due to global climate change, disease and pest attack as well as genetic erosion due to other developmental activities. Besides these, the other challenges for crop production like increasing yield potential through modified plant type and altered or new environments are major concern. The availability of phenotypic characterizations of the Indian rice landraces is of supreme importance for the development of new improved rice varieties, which could bolster the rice systems towards greater economic and environmental sustainability. Characterizing the available landraces of rice at regional level with farmers' participation is utmost important for effective crop management in the changed climatic regime. Hence, an attempt has been made in the present study to characterize rice landraces and assess their performance under organic farming/natural farming system. This study would provide valuable information on the performance of rice landraces under organic/natural farming system thereby pave way for developing protocols and institutional systems for multiplication, procurement, processing and supply of quality seed of potential landraces of rice suitable for multi cropping system and to establish a niche market for rice landraces through value addition, formation of cooperatives and backward integration through appropriate market tagging and labeling. Participatory selection and patronage for important potential rice landraces under the study that would fit into sustainable cropping system models so as to eventually channelize them in harmony with the formal seed chain for increasing the farm income of marginal farmers of the region.

MATERIALS AND METHODS

The present study was conducted in Athota village of Guntur District-coastal plains (202) landraces), Andhra Pradesh, India during rainy season (*Kharif*) of 2019. The landraces of paddy were augmented from Andhra Pradesh, Odisha, Karnataka and Tamil Nadu states through seed melas and farmer networks in respective states. The augmented rice germplasm was sown in well prepared seed beds for nursery development. Seedlings of paddy landraces were

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transplanted to experimental plots (10 m x 5m – length and width in blocks with 25x25cm plant to plant & row to row spacing with two replications). Recommended natural farming practices were followed such as seed treatment with *Beejamruth*, application of farm yard manure in the experimental field, transplantation of 14-15 days younger seedling to the trial field, weeding, Spray of *Dravajeevamurth* at the regular intervals (once in 15-20 days), pest control measures using *Neemastra* and *Agniastra* through various stages of crop growth and landrace-wise harvesting and threshing. The qualitative traits recorded are as follows: Leaf: Pubescence of blade surface, Basal leaf: Sheath colour, Leaf Aricule/ ligule, Leaf: Shape of ligule, Leaf: Colour of ligule, Flag leaf: Attitude of blade (early observation), Count of spikelet: Density of pubescence of lemma, Lemma: Anthocyanin colouration of apex, Stem: Anthocyanin colouration of internodes, Spikelet: Colour of tip of lemma, Flag leaf: Attitude of blade (late observation), Count of Panicle: Curvature of main axis and the quantitative traits recorded are Plant height (cm), Number of total tillers, Number of effective tillers, Days for Maturity, (days), Panicle:Length (cm), Grain yield /plant (g) and 1000-seed weight (g) respectively. Observations were recorded on five randomly chosen plants of rice landraces per genotype per replication for twelve qualitative and seven quantitative traits at different stages of growth as per the DUS guidelines of PPV&FRA. Descriptive statistical analyses for quantitative traits were carried out using MS-Excel. The phenotypic frequencies of qualitative characters were also used for computing Shannon–Weaver information index (Shannon and Weaver, 1963) in order to estimate the diversity in different qualitative traits. The diversity index (H) was calculated as presented by Negassa (1985):

$$H = -\sum_{i=1}^{n} pi \log pi$$

where, *pi* is the proportion of the accessions in the *i* th class of an *n*-class character.

RESULTS AND DISCUSSION

Rice is one of the most important cereal crops of the world feeding more than 50% of global population. Around 90% of the global rice is cultivated and consumed in Asia, where 60% of the earth's people habituated. In addition, it is grown in more than 100 countries around the world in all the continents except in Antartica (Shailesh Tiwari *et al*., 2020). Table 1 presents the rice landraces/varieties used in the experimental study. To characterize 202 rice landraces/varieties augmented from Andhra Pradesh, Odisha, Karnataka and Tamil Nadu, 19 traits (12 qualitative and 7 quantitative) have been used. Qualitative characters are considered as morphological markers in the identification of landraces of rice, because they are less influenced by environmental changes (Raut, 2003). The variability recorded in select qualitative traits of rice landraces is presented in Table 2. Thus, agro-morphological characterization should eventually lead to a system of recording and storing useful data that can be readily retrieved and made available to others and help in planning breeding programmes (Deepak Sharma and Satyapal Singh, 2018).

Variability in qualitative traits

Leaf: Pubescence of blade surface

Among the landraces studied, 22% (44 landraces) are without pubescence on leaf blade surface while, 4% (9) and 74 % (149) are with medium and weak pubescence respectively. Shannon diversity index value recorded for this trait is 0.3019.

Basal leaf: Sheath Colour

Basal leaf sheath colour is one of the important characters in identifying mixtures at the seedling stage. It is observed that farmers therefore, grow landraces/varieties having some distinct basal pigmentation type in paddy growing regions of the Indian sub-continent. Out of the landraces/varieties (202) studied 201 possessed green leaf sheaths while, only one landrace with purple leaf sheath (see table 2). The diversity index observed for the above trait was 0.0136 indicating that less diversity among the traits studied.

Leaf Aricule/ ligule

Interestingly, all the landraces/varieties selected for the study are with the presence of leaf aricule/ligule.

Leaf: Shape of ligule

The leaf shape of ligule is acute in 9 landraces and split in 193 landraces with a diversity index of 0.079.

Leaf: Colour of ligule

The colour of ligule recorded in the landraces of paddy is light purple (84%), purple (1%) and white (15%). Majority of landraces possessed light purple ligule (168 landraces), while only 2 landraces are with purple ligule respectively.

Flag leaf: Attitude of blade (early observation)

Early observation of on attitude of blade in flag leaf indicated that only two landraces are deflexed and majority (175 landraces) are of semi-erect type followed by erect (25 landraces) with shanon diversity index value of 0.1861.

Count of Spikelet: Density of pubescence of lemma

The density of pubescence of lemma of the rice landraces studied are broadly categorized in to four groups *viz*., Strong, medium, weak and absent with landraces 1, 14, 184 and 3 respectively. The diversity index recorded for the trait is 0.1558.

Lemma: Anthocyanin colouration of apex

Anothocyanin colouration on the apex of lemma are absent in ninty-three (93) landraces, weak in 91 landraces, medium in 16 landraces and strong in only two landraces studied with a diversity index of 0.4182.

Stem: Anthocyanin colouration of internodes

The presence of purple lines and purple colour in internodes are considered to be a primitive character. Of the 202 landraces studied, 198 possessed internode colouration while 4 landraces lacked the presence of internode colouration. The diversity index for the trait recorded is 0.0422.

Spikelet: Colour of tip of lemma

The glume colour helps in identification of one variety/landrace from the other. The glume colour varied from black (7%), purple (5%), red (53%), white (34%) toYellow (1%) and brown. The diversity value recorded for this qualitative trait is 0.508.

Flag leaf: Attitude of blade (late observation)

Late observation of on attitude of blade in flag leaf indicated that only seven landraces are deflexed and majority (161 landraces) are of semi-erect type followed by erect (34 landraces) with Shannon diversity index value of 0.2594.

Count of Panicle: Curvature of main axis

Majority of the landraces (191) are categorized into semi-erect followed by deflexed (10) and erect (1) respectively with a diversity index of 0.099.

Variability in qualitative traits

The spectrum of variability in respect of certain quantitative characters of rice landraces/varieties is presented in Table 3. Variability had been observed in all the quantitative traits studied for the rice landraces under natural farming/organic farming environment.

Plant height

Plant height ranged from 22.8 cm (*Ara Baihar variety)* to 169.8 cm (*Thumba dhan* landrace) with a mean value 128.0 cm. The coefficient of variation (CV%) recorded for the trait is 16.4% indicating moderate variability for plant height among the landraces of rice studied. 110 landraces are categorized into very tall category (130 cm and above), 58 landraces under tall category (110-130 cm), 25 landraces under semi-tall category, 9 landraces under semi-dwarf category (91.0-110.0 cm) and two varieties are under dwarf category (<70 cm). Very tall and tall landraces may be preferred for fodder and thatching purposes and other groups are to be explored to suit to yield and land type.

Number of total tillers

Number of total tillers varied from 9.6 to 53.4 with a mean value of 32.2. *Gangabaru* rice landrace recorded the least number of tillers while, *Dhabali* landrace recorded the highest number of tillers (53.4). Highest CV% of 38.2% recorded for the trait (number of total tillers) among all the quantitative traits studied in the 202 landraces/varieties of rice in the present study.

Number of effective tillers

The number of effective (panicle) bearing tiller has a direct role in increasing yield of rice landraces. It is observed that, it ranged from 8.6 to 24.2 with a mean value of 13.7. *Chapati Gurmatiya* landrace of rice recorded the less number of effective tillers (panicle bearing/reproductive) while, *Jatiya* and *Gethu* (24.2) landraces recorded maximum number of productive tillers.

Days for maturity

Days to maturity in the paddy landraces studied ranged from 110-140 days with a mean value of 129.2. *Navara* landrace (a Kerala medicinal rice) recorded the earliest maturing crop with 110 days while, *Kudarath* landrace recorded the maximum days for crop maturity (140 days).

Panicle length

Panicle length varied between 14.2 cm and 84.2 cm with a mean value of 24.9 cm. *Chinikumini* landrace of rice recorded the least length of panicle (14.2 cm) while, *Kandasagar* and *Lalu chuda* recorded 62.6 cm and 84.2 cm respectively.

Grain yield per plant

A good variability exists among traditional landraces of rice for the trait grain yield per plant. *Lalakamini*, rice landrace recorded the least yield of 94 grams, followed by *Bavansgaja* -97 grams while, *Master Patnai* recorded the highest grain yield of 402 g per plant.. Interestingly, yield per plant recorded the highest sample variance value of 2406.7 among the quantitative traits studied (Table 3).

1000-seed weight

It ranged from 11.0 g to 45.0 g with a mean value of 34.3 g. Highest value for the test weight (45.0 g) observed in *Jawa phul, Baramite nayive, Mali fule, Lochai* and *Annapurna, SL-3* and the least value of 11.0 g recorded for *Baisa madi* landrace of rice.

Phylogenetic relationships

Similarity coefficient matrix (Table 4) showed highest correlation (r=0.3666) between total number of tillers and grain yield per plant followed by total number of tillers and number of effective tillers (r = 0.2887), grain yield per plant and test seed weight (r = 0.2634), panicle length and plant height (r = 0.2075), test seed weight and days to maturity (r = 0.19), total number of tillers and days to maturity (r = 0.092), total number of tillers and panicle length (r=0.07), test seed weight and number of effective tillers (r = 0.069). Analysis of variance (ANOVA) result confirmed that the variations exist within all the quantitative traits studied viz., plant height, number of total tillers, number of effective tillers, days for maturity, panicle length, grain yield per plant and test seed weight (Table 5).

Similar variability in qualitative, quantitative and phylogenetic relationships in rice landraces have been recorded by earlier researchers (Chiaki Muto *et al*., 2019; Deepak Sharma and Singh, 2018; Gabriele Mongianoa *et al*., 2020; Nilamani Dikshit *et al*., 2012, 2014; Vimla Bisht *et al*., 2007; Satya *et al*., 2007; Sivaraj & Pandravada , 1996; Sivaraj et al., 2014; Subba Rao et al., 2013). However, the present study is unique as it was carried out totally in a natural farming/organic farming environment. The proportion of genetic diversity in autogamous species, such as rice, is expected to be greater

amongst those within each landraces (Nilamani Dikshit *et al*., 2013). The analysis of sample variance showed that there is enough variation present between and within landraces populations. The variations present among the landraces are more than variations present within the landraces. Thus, for conservation point of view it is important to conserve as many landraces populations as possible with optimum population size under natural farming/organic farming systems.. The variations due to environmental adaptations provide important donor germplasm for crop improvement to users. Further, understanding the population genetic structure will be helpful in monitoring diversity loss over time and space, and also for devising a rational conservation plan for management of farmer landraces on-farm under natural farming/organic farming environment.

The present study indicates that considerable diversity in rice landraces populations could be maintained *on-farm* under natural farming/organic farming environment. In context of crop varietal diversity it has been reported that considerable crop genetic diversity continues to be maintained *on-farm*, in the form of traditional crop varieties (Jarvis *et al*., 2000, 2008). However, the urban encroachment of farmland, unsustainable use of natural resources, promotion of genetically uniform varieties, introduction of alien invasive species, changing pattern of human consumption, absence of or inappropriate legislation and policy and climate and other environmental changes lead to replacement of local varieties needs to be addressed.

The present study is paving way for developing pathways for enhancing seed security while strengthening seed system robustness for rice landraces at regional level. Conservation is an important initiative, its alone doesn't bring much difference -along with that bringing the diversity back in production systems and plates is very much needed. For those decentralized seed systems, managed by Farmer producer organizations (FPOs) / Women self-help groups (SHGs) which caters the needs of farmers locally - backed up by public investments and R&D is required.

Table 1. Rice landraces/varieties used in the Study

S.No.	Name of Rice landrace/variety	S.No.	Name of Rice landrace/variety	S.No.	Name of Rice landrace/variety
1	4002/SIKICHALI	**38**	4037/RAM JEERA	**75**	4075/DHIMIBD
2	4003/RAKTHASALI	**39**	4038/KULLAKAR	**76**	4076/THITAR PAKI JUNE
3	4004/DASARABATHI	**40**	4039/DASAMATHI	**77**	4077/AGAN DHAN
4	4005/KAMINI BHOG	**41**	4041/DUDESWAR	**78**	4078/BADANALI
5	4006/MAINAGALI	**42**	4042/TULASI BASO	**79**	4079/DENGBARI
6	4007/KOURANDI	**43**	4043/KANDA SAGAR	**80**	4080/BODHIDHAN
7	4008/GANGABARU	**44**	4044/BISA MADI	**81**	4081/NAVARA
8	4009/KALALENGADI	**45**	4045/SUGANDA BATTI	**82**	4082/SANNAJAJULU
9	4010/KUJIPATALIA	**46**	4046/PADMA KESARI	**83**	4083/RUBAFUL
10	4010/KUJIPATALIYA	**47**	4047/KUKUDA MUNDHA	**84**	4084/KHADAM FUL
11	4011/RADHA PAGAL	**48**	4048/BAISA MADI	**85**	4085/GADAKODINA MALI
12	4012/DHABALI	**49**	4049/KARUM GURUVAI	**86**	4086/MULULU GREEN
13	4013/BALARAMSAL	**50**	4050/BANSA GUTI	**87**	4087/BIRA MANI
14	4014/DUBARAJ	**51**	4051/KERALA MEDICINAL RICE	**88**	4089/MALABAR
15	4015/SAMUDHRALAHARI	**52**	4052/LOCHAI	**89**	4090/GUMARA
16	4015/SAMUDRALAHARI	**53**	4053/THANU	**90**	4091/LAGHU BHOTA
17	4016/LALAKAMINI	**54**	4054/BHUSALI	**91**	4092/ALASIKABA
18	4017/GANGABALU	**55**	4055/BAHURUPI	**92**	4093/CHINAPACKED
19	4018/BAVANSGAJA	**56**	4056/GEDI KAYHE	**93**	4094/BADAOSHA
20	4019/SALDETHI	**57**	4057/LALA KALAMA	**94**	4095/MALA GOWRI
21	4020/ALASAKIBA	**58**	4058/GATIA	**95**	4098/BARA GALI
22	4021/BHATADHAAN	**59**	4059/KARIKASNARVAL	**96**	4099/KALAMA KATHI
23	4022/DESISHIV	**60**	4060/BODHI DHAN	**97**	4100/BHATA SAPARI
24	4023/GEYOSE	**61**	4061/RAI SRI	**98**	4101/MALIFUL
25	4024/UJALA MANIPAL	**62**	4062/KUTIA	**99**	4102/HAVALICOH
26	4025/KALACHAMPA	**63**	4063/KADHAN FUL	**100**	4103/KALA GORA
27	4026/KIRAT	**64**	4064/KALACHAKI	**101**	4104/RANI KAJAL

28	4027/BALUDUBARAJ	**65**	4065/JEERA SAMBA	**102**	4105/DEHRADUN GANDHESWAR
29	4028/CHINIKUMINI	**66**	4066/SIDDA SANNA	**103**	4106/KUSUMA
30	4029/KALASARIYA	**67**	4067/ARA BAIHAR	**104**	4107/UMAR PAUL
31	4030/PANCHARATNA	**68**	4068/KUNKUMASALI	**105**	4107/UMAR PHUL
32	4031/BARMABLACK	**69**	4069/AGARALI	**106**	4109/BATA KALAMA
33	4032/BAHURUPI	**70**	4070/BIRAM SLUB	**107**	4112/AHADAM PHUL
34	4033/KUDARATH	**71**	4071/KHOTALA	**108**	4112/AHADAMPWL
35	4034/KUNKUMA SALI	**72**	4072/CALCHAR	**109**	4113/SUDI DHANIYA
36	4035/GHANI	**73**	4073/RED JASMIN	**110**	4114/NILA MANI
37	4036/KEMPUSANNA	**74**	4074/JATIA	**111**	4115/KENDUMANGIA
S.No.	**Name of Rice landrace/variety**	**S.No.**	**Name of Rice landrace/variety**	**S.No.**	**Name of Rice landrace/variety**
112	4116/GETHU	**149**	4154/MAHADEI	**186**	4212/MAHEK SALL
113	4117/SAHFAL	**150**	4156/SL-3	**187**	4213/PADMINI
114	4118/THUMBA DHAN`	**151**	4157/JAWA PHUL	**188**	4214/BAKADHAN
115	4119/LALU CHUDA	**152**	4158/NIRIMANI	**189**	4215/CHENACHAR
116	4120/JUBRI DHAN	**153**	4159/BADA GANDHAMALA	**190**	4216/SALVA GAJA
117	4121/MEGAMALA	**154**	4170/JALAKA	**191**	4217/HALLA BATTA
118	4122/DHABALI	**155**	4175/DELHI BASMATHI	**192**	4218/JP10
119	4123/BANA PURI	**156**	4181/CHARMONI	**193**	4219/UNDOOR MALLIGE
120	4124/LALA KALAMA	**157**	4182/ISUKA SANNALU	**194**	4220/CHAPATI GURMATIYA
121	4125/DASBAMAT	**158**	4183/BOUVANI	**195**	4221/DANDA BALUNGA
122	4126/DEVARANI	**159**	4184/BALU DUBRAJ	**196**	4222/BILOI LODEI
123	4127/BIR ODLU	**160**	4185/BASMATHI	**197**	4223/MASURI
124	4128/KANDA SAGAR	**161**	4186/RATNA CHUDI	**198**	4224/DEHRADUN RED RICE
125	4130/BAWSHKATHI	**162**	4187/KULAJINA	**199**	4225/RATNA SALI
126	4131/MAHIPAL	**163**	4188/EKALDHAN	**200**	4226/DUMEV FUL
127	4133/CHANDRAKALA	**164**	4189/BHELI NALI	**201**	4227/ANNAPURNA
128	4134/CHATIKA	**165**	4190/ROBA PHUL	**202**	4228/KAKARA GANDHA
129	4135/SURMATIA	**166**	4191/DEDDA BATTA		
130	4135/SURMATIYA	**167**	4192/CHUDI DHAN		
131	4136/BALARAM SAL	**168**	4193/LALA BOSHA BHOG		
132	4137/NAVARA	**169**	4194/LOCAL		
133	4138/MASTER PATNAI	**170**	4195/BOUVANI		
134	4139/THENGI CHUDI	**171**	4196/MULULU		
135	4140/BASUMATHI BAM	**172**	4197/CHINAMALI		
136	4141/TULASI FUIA	**173**	4198/SURMATI 9		
137	4142/DHABALI	**174**	4199/LOCHAI		
138	4143/THINGA SHALA	**175**	4200/JAN JHIOUSH		
139	4144/BARAMITE NAYIVE	**176**	4201/GANGAVALI		
140	4145/ASIM CHUDI	**177**	4203/BHOGADI		
141	4146/MALI FULE	**178**	4204/BATA SAPARI		
142	4147/KOMAL	**179**	4205/SANA MALI		
143	4148/DURGA	**180**	4206/KAINCHA FULA		
144	4149/KALABHAT	**181**	4207/SESH FAL		
145	4150/LALGATHU	**182**	4208/KARKAVE		
146	4151/MALIFUL JULI	**183**	4209/TAPANG		
147	4152/KANTA SOLA	**184**	4210/CHINTALU NIDATI		
148	4153/LALU CHUDA	**185**	4211/HERUA JOHA		

Table 2. Variability in qualitative traits observed in the paddy landraces

S.No.	Trait/descriptor	Descriptor state	Frequency	%	Shannon diversity index
1	Leaf: Pubescence of blade surface	Absent	44	22	0.3019
		medium	9	4	
		weak	149	74	
2	Basal leaf: Sheath Colour	Green	201	100	0.0136
		Light Purple	1	-	
3	Leaf Aricule/ ligule	Present	202	100	0.0000
4	Leaf: Shape of ligule	Acute	9	4	0.0791
		Split	193	96	
5	Leaf: Colour of ligule	Light Purple	168	84	0.2132
		Purple	2	1	
		White	32	15	
6	Flag leaf: Attitude of blade (early observation)	Defelxed	2	1	0.1861
		Erect	25	12	
		Semi Erect	175	87	
7	Count of Spikelet: Density of pubescence of lemma	Absent	3	1	0.1558
		Medium	14	7	
		Strong	1	0	
		Weak	184	92	
8	Lemma: Anthocyanin colouration of apex	Absent	93	46	0.4182
		Medium	16	8	
		Strong	2	1	
		Weak	91	45	
9	Stem: Anthocyanin colouration of internodes	Absent	198	98	0.0422
		Present	4	2	
10	Spikelet: Colour of tip of lemma	Black	14	7	0.5080
		Brown	1	-	
		Purple	9	5	
		Red	107	53	
		White	69	34	
		Yellowish	2	1	
11	Flag leaf: Attitude of blade (late observation)	Deflexed	7	3	0.2594
		Erect	34	17	
		Semi-erect	161	80	
12	Count of Panicle: Curvature of main axis	Deflexed	10	5	0.0990
		Erect	1	-	
		Semi-erect	191	95	

Table 3. Descriptive statistical analysis of quantitative traits of paddy landraces

Trait	*Min*	*Maximum*	*Mean*	*Sample variance*	*Standard deviation*	*CV%*
Plant height (cm)	22.8	169.8	128.0	441.6	21.0	16.4
Number of total tillers	9.6	53.4	32.2	150.8	12.3	38.2
Number of effective tillers	8.6	24.2	13.7	441.6	2.9	21.4
Days for Maturity (Days)	110	140	129.2	19.0	10.1	3.4
Panicle:Length (Cm)	14.2	84.2	24.9	32.3	5.7	22.8
Grain yield /plant (g)	94.0	402	228.3	2406.7	49.1	21.5
1000-seed weight	11.0	45.0	34.3	17.6	4.2	12.2

Table 4. Correlation coefficient matrix of the select quantitative characters of rice landraces

	NET	*PHT*	*PLT*	*DMY*	*TSW*	*GYP*	*NTT*
NET	1						
PHT	-0.01813	1					
PLT	-0.03205	0.207596	1				
DMY	0.029136	0.028121	0.090251	1			
TSW	0.069532	-0.03979	0.055974	0.19055	1		
GYP	0.040252	-0.0375	-0.02841	0.139837	0.263399	1	
NTT	0.288732	0.107472	0.070001	0.092538	0.023511	0.366648	1

NET-Number of effective tillers; *PHT*- Plant height (cm);*PLT*- Panicle length (Cm); *DMY*- Days for Maturity (Days); TSW-Test seed weight (g); GYP-Grain yield per plant; NTT-Total number of tillers

Table 5. ANOVA of different quantitative characters of rice landraces

Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	7762056	6	1293676	2943.337	<0.001	2.105014
Within Groups	618414.5	1407	439.527			
Total	8380471	1413				

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