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Study on Analysis of Variance on the indigenous wild and cultivated rice species of Manipur Valley

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ABSTRACT

The analysis of variance revealed considerable variation among the cultivars and the wild species for yield and other quantitative characters in both the years of investigation. The highly significant differences among the cultivars in year wise and pooled analysis of variance for all the 12 characters reveal that there are enough genetic variabilities for all the characters studied. The existence of genetic variability is of paramount importance for starting a judicious plant breeding programme. Since introduced high yielding rice cultivars usually do not perform well. Improvement of indigenous cultivars is a clear choice for increase of rice production. The genetic variability of 37 rice germplasms in 12 agronomic characters estimated in the present study can be used in breeding programme

Keywords : Rice; Heritability; phenotypic coefficient of variation; genotypic coefficient of variation

1 INTRODUCTION

Manipur, in the north-eastern corner of India bordering Myanmar, lies between 93.03° E to 94.78° E longitude and 23.83° N to 25.68° N latitude with a total geographical area of 22,327 sq. km. The state is rectangular in shape with a little precious valley with an area of about 1,850 sq. km. which is encircled by mountain ranges. The altitude of the valley ranges from about 780 m to 800 m above MSL with subtropical climate. The maximum and minimum temperatures in the valley reach up to 35° C during the month of May and June and went down up to 0° C during the month of December and January. The average annual rainfall is about 1,334 mm with heavy precipitation during the month of June and July. The soil of the valley is mostly clay to heavy clay with high organic carbon content in the low lying areas. The pH of the soil ranges from 5.4 to 6.8. Rice based agriculture is the single largest source of livelihood of the majority of rural masses and is the mainstay of the state's economy. Out of the total cultivated area of about 2.1 lakh hectares in the state, the area under kharif rice is about 1.95 lakh hectares which is about 93 percent of the net cultivated area. About 15,000 hectares, rice is grown as pre-kharif crop under irrigated wet land system. The state has an annual average rice production of about 388 thousand metric tones. Conservation of biodiversity in the wake of depleting natural resources has assumed considerable significance and worldwide importance. Land races, traditionally grown primitive cultivars and wild relatives of cultivated plants are the basic raw materials that not only sustained the present day crop improvement programmes but are also required to meet the aspirations of future generations to face unforeseen challenges of biotic and a biotic stresses. The magnitude of heterosis in crop plants depends on the degree of genetic divergence between parental stocks and consequently, may be used as an indicator of the inherent yielding capacity of a cross. While the importance of genetic diversity has long been appreciated by breeders, the basic difficulty has always been one of recognizing and estimating such diversity, short of actually making the cross. In view of the great importance of genetic diversity to breeding, techniques which can provide direct and reliable quantitative estimates of diversity at the genotypic level should prove to be valuable In order to have an extensive breeding programme for high yields and response to inputs, the knowledge of genetic diversity in the crop is essential. For efficient use of germplasms in breeding programme the germplasms need to be systematically characterized with the traits which have high degree of habitability so that the cultivars can be identified with reasonable degree of certainty under varied environmental conditions.

2 MATERIALS AND METHOD

Thirty-two genetically diverse indigenous rice germplasms and five wild rice of which three from Manipur and two wild rice procured from IRRI, Philippines were used for the present study. These germplasms were grown in the experimental farm of Manipur University, Manipur, India. The experiment was laid out in the research field of the University in the Randomized Block Design with three replications. The inter row spacing were maintained at 20 cm. Ten plants from middle three rows of each plot were randomly sampled and the quantitative characters were recorded following actual measurement on each of the sampled plants and then averaged it out. The qualitative traits were recorded through visual observation only. The variables measured were Flag leaf length, Flag leaf width, Ligule length, Culm diameter, Panicle length, Culm length, Ear bearing tillers/plant, Days to 50% flowering, Grain length, 100 grain weight, Spikelet/ Panicle, Grain yield/Plant. The experimental data for each year was analysed statistically by the method of analysis of variance for single factor experiments "[1]". For significance of the calculated variance ratio, the value was compared with the table value of "F" distribution.

2.1 Statistical Analysis of Data

All computational works for analysis of variance and canonical analysis were carried out with the help of HCL-380 DX Computer with mathematical co-processor at the College of Agriculture, Central Agriculture University, Iroisemba, Imphal using SPAR-1 programmes of Indian Agricultural Statistic Research Institute (IASRI), New Delhi. Graphical representation of genetic divergence of varieties through canonical analysis following "[2]", "[3]. The procedures of calculation are as under.

The sum squares and sum of products were computed from transformed mean value (Y) for each character and character combinations were presented in the matrix A_{pxp} from A, A^p was calculated when p is the number of characters. The procedures of calculation are as under. The sum squares and sum of products were computed from transformed mean value (Y) for each character and character combinations were presented in the matrix A_{pxp} from A, A^p was calculated when p is the number of characters.

2.2 Calculation of first standardized Vector (V_1) and Canonical Root (λ_1)

The first approximation trial vector was calculated after obtaining column totals of matrix A_{pxp} and dividing each of the column totals by the heighest quantity among them. The second approximation trail vector was again calculated by multiplying each column of A^p matrix by the first approximation trail vector to obtained another column totals and dividing each value of column totals by the highest numerical value among them.

2.3 Contribution of vectors towards divergence

Total contribution of all vectors = Sum of diagonal elements of A vectors

Per cent contribution of λ = (λ/ total contributions of vectors) X 100.

2.4 Two dimensional graphical representations

If the total percentage contribution of l_1 and l_2 exceeded 70% of total contribution of vestors, two dimentional graphical representation using Z_1 and Z_2 values is adequate. "[4]".

3 Result ans Disucssion

The analysis of variance revealed considerable variation among the cultivars and the wild species for yield and other quantitative characters in both the years of investigation. However the cultivars did not differ significantly for culm diameter and culm length in both the years. The estimates of genotypic coefficient of variation (Table 1) indicated maximum genetic variation in both the years for grain yield/plant (36.90, 37.40) followed by ligule length (26.22, 27.28), spikelets/panicle (24.00, 24.44) and ear bearing tillers (23.16, 24.99). Their respective estimates of phenotypic coefficient of variation were also high and their difference with GCV estimates was low. For culm diameter GCV and PCV estimates were very high in 2009 while these were very low in 2010. The estimates of heritability (Table 1) revealed very high estimates for ligule length (99.19, 98.40), grain yield /plant (97.95, 98.69) 100 grain weight (96.07, 95.95), days to 50% flowering (92.43, 90.43) and flag leaf length (90.54, 83.06). Culm diameter exhibited high heritability (88.09) in 2010 while comparatively lower heritability (49.93) in 2009. Likewise culm length exhibited very high heritability (97.29) in 1996 while very low estimate (5.60) was recorded.

3.1 Canonical analysis

The canonical vectors and two dimensional representation of the relative positions of germplasms in the Z1 and Z2 graph have reflected, by and large, the similar results in the mechanism of genetic in the size co- efficient in the first two canonical vectors indicated that spikelet number/panicle, ear bearing tillers/plant constituted the primary axis of differentiation while ear bearing tillers/plant, grain length, days to 50% flowering, panicle length, grain yield/ plant, 100 grain weight were important secondary axis of differentiation. These results confirmed the contribution of grain yield/plant, spikelets/Panicle, 100 grain weight, grain length, days to 50% flowering, ear bearing tillers/plant and flag leaf length towards the genetic divergence in D2 analysis while superimposing the groupings obtained through D2 analysis by Tocher's method an the canonical graph, the scattered points of Z1 and Z2 values were in general agreement with the grouping obtained in D2 analysis which further confirmed the validity of the groups of cultivars.

Heritability for ligule length, grain yield per plant, 100 grain weight, days to 50% flowering and flag leaf length are very high which indicate high genetic variability without heterozygote effect, as rice is a self pollinated species, and low

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Table 1. Pooled mean Perse performance in respect of 12 agronomic characters of local rice germplasms of Manipur Valley

Acc. No	Flag leaf length	Flag leaf	Ligule length	Culm diameter	Panicle length	Culm length	Ear bearing tiller plant	Days to 50% flowering	Grain length	100 grain weight	Spikelet number	Grain number
1	23.93	1.84	1.82	1.42	19.42	122.87	7.50	100.83	2.36	3.80	88.27	21.87
2	34.03	1.37	1.33	0.75	23.58	142.00	8.33	113.17	0.86	2.92	107.78	30.12
3	38.09	1.64	1.22	0.89	23.40	155.48	7.83	112.50	0.91	2.81	104.06	35.05
4	35.89	1.82	1.33	0.92	25.62	139.08	8.67	114.67	0.92	2.99	104.34	37.97
5	29.57	1.84	1.35	0.70	23.20	140.80	8.83	110.17	0.90	2.66	111.57	28.25
6	34.83	1.81	2.03	0.79	24.48	142.17	7.17	99.83	0.88	2.48	97.99	32.67
7	35.40	1.66	1.77	0.92	27.56	145.40	7.33	116.40	0.89	2.50	130.64	39.14
8	41.03	1.78	1.45	0.85	26.65	147.20	9.50	118.57	0.88	2.88	140.33	38.44
9	31.32	1.43	2.12	0.88	24.57	137.41	11.17	117.33	0.87	3.01	135.73	39.60
10	35.40	1.41	1.49	0.79	26.10	128.45	9.00	101.50	0.86	3.07	138.67	34.25
11	33.00	1.45	1.96	0.76	22.23	153.42	11.67	103.50	0.88	2.51	97.32	35.42
12	36.01	1.66	1.48	0.83	24.52	145.75	13.83	113.83	0.90	2.59	124.83	32.53
13	30.35	1.35	1.34	0.79	24.75	135.05	9.50	106.00	0.81	2.96	134.40	26.70
14	34.03	1.47	1.37	0.60	22.53	150.28	8.00	116.33	0.83	2.78	137.48	37.30
15	37.20	1.70	1.94	0.73	23.10	155.87	9.00	117.50	0.92	2.88	132.38	35.52
16	36.20	1.51	1.60	0.81	25.34	145.17	8.17	122.00	0.88	2.93	126.32	31.88
17	34.40	1.59	1.78	0.89	26.00	89.27	7.67	105.33	0.87	2.37	115.76	31.13
18	38.29	1.49	1.70	0.71	22.27	121.13	10.67	87.33	0.77	2.54	73.35	43.85
19	34.79	1.22	2.20	0.74	20.98	159.00	10.50	115.50	0.85	3.05	65.28	24.28
20	36.87	1.59	2.28	0.93	24.39	147.77	8.33	119.33	0.91	3.05	151.73	33.33
21	34.74	1.64	3.06	0.86	25.98	146.35	9.50	121.17	0.94	2.54	133.85	44.95

Acc. No	Flag leaf length	Flag leaf	Ligule length	Culm diameter	Panicle length	Culm length	Ear bearing tiller plant	Days to 50% flowering	Grain length	100 grain weight	Spikelet number	Grain number
22	34.82	1.49	2.44	0.70	25.87	144.85	13.67	119.67	0.92	2.85	133.38	42.78
23	51.19	1.64	2.27	0.75	24.75	146.53	10.33	115.33	0.98	2.92	116.74	40.01
24	42.66	1.43	2.16	0.80	22.21	144.97	11.00	114.33	1.20	3.00	114.46	40.01
25	39.97	1.77	1.83	0.85	24.49	146.07	7.83	117.17	0.91	2.86	99.85	34.07
26	35.18	1.67	1.45	0.78	22.14	135.37	8.33	119.00	0.91	2.66	114.92	31.28
27	38.21	1.54	2.08	0.57	22.65	132.5	8.17	105.17	0.92	2.98	81.30	35.90
28	37.10	1.50	2.26	0.91	24.48	155.72	9.83	120.33	0.88	2.50	94.69	31.98
29	33.88	1.42	1.59	0.75	25.57	135.53	12.67	117.17	0.86	2.78	111.17	21.57
30	34.63	1.55	2.31	0.68	25.18	152.50	10.67	97.33	0.89	2.27	76.00	24.12
31	33.58	1.50	1.58	0.83	22.52	144.85	11.50	94.33	0.94	2.59	116.27	24.08
32	39.31	1.57	1.37	0.87	21.82	137.58	11.67	104.40	0.91	2.59	83.93	35.42
33	31.10	1.40	1.86	0.77	20.93	73.87	5.50	100.40	0.98	2.21	85.83	13.77
34	27.84	1.30	2.10	0.80	25.38	184.23	5.83	104.00	0.93	1.89	84.17	6.48
35	19.44	0.97	2.13	0.71	20.97	111.40	6.67	106.17	0.89	1.88	79.17	5.22
36	19.86	1.34	2.12	0.80	19.75	101.27	5.67	103.00	0.90	1.85	56.67	6.35
37	24.22	1.39	2.69	0.89	26.10	93.40	6.00	99.33	0.82	1.97	94.17	9.12

environmental component of variance for these characters. However the cultivars did not differ significantly for culm diameter and for culm length. The estimates of genotypic coefficient of variation indicated maximum genetic variation in both the years for grain yield/plant followed by ligule length spikelets/panicle and ear bearing tillers .Their respective estimates of phenotypic coefficient of variation were also high and their difference with GCV estimates were low. For culm diameter GCV and PCV estimates were very high in 2010 while these were very low in 2009. The estimates of heritability revealed very high estimates for ligule length grain yield /plant 100 grain weight days to 50% flowering and flag leaf length Culm diameter exhibited high heritability in 2010 while comparatively lower heritability in 2009. Likewise culm length exhibited very high heritability in 2009 while very low estimate was recorded in 2010. The highly significant differences among the cultivars in year wise and pooled analysis of variance for all the 12 characters reveal that there are enough genetic variability's for all the characters studied. The existence of genetic variability is of paramount importance for starting a judicious plant breeding programme. Since introduced high yielding rice cultivars usually do not perform well. Improvement of indigenous cultivars is a clear choice for increase of rice production. The genetic variability of 37 rice germplasms in 12 agronomic characters estimated in the present study can be used in breeding programme.

4 Conclusion

The salient findings obtained from the present studies and their possible implications in the genetic improvement of indigenous and wild rice germplasm of Manipur are summarised. In the studies of variability among the rice germplasms, a wide range of agronomic characters and high values of variance at genotypic and phenotypic levels were estimated suggesting the possibilities of effective selection for various agronomic characters.

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