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# PRINCIPAL COMPONENTS ANALYSIS IN RICE GENOTYPES GROWN OVER SEASONS

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## Abstract

Data were collected on 50 genotypes of rice grown over two seasons for eleven agronomical traits. Both individual and pooled analyses were performed. Among the traits of interest, high coefficients of variation were observed for total number of tillers per plant, number of productive tillers per plant and total dry matter production per plant in season 1, season 2 as well as in pooled analysis. All the eleven traits were statistically significant when subjected to univariate statistics. Principal component analysis resulted in the first three components account for more than 89 per cent of total variation in season 1; 83 per cent of total variation in season 2 and 86 per cent of total variation in pooled analysis. These results could well be used in by rice breeders to develop high yielding lines and new breeding protocols for rice improvement.

***Key words :*** Rice; coefficient of variation; Principal components analysis.

## Introduction

Rice is considered as an important food crop in India and millions of people depend on it for their livelihood. The development of high yielding lines is a continuous process and its success rests on the proper selection of suitable plants to be utilized in cross breeding programme. The effectiveness of selection depends primarily upon the quantum of genetic variability available in the germplasm. A large number of traits are often observed by rice breeders. Some of which may not be use in the discrimination of the germplasm. In such cases principal component analysis (PCA) may be used to reveal patterns and eliminates redundancy in data sets (Adams, 1995; Amy and Prittes, 1991; Majiand Shaibu, 2012). Principal component analysis was designed by Karl (1901) and Hotelling (1933) indicated that PCA is an exploratory tool, to identify unknown trends in a multi-dimensional data set. PLA is one among many techniques that reduced the data into two dimensions (Smith, 2002; Rao, 1964; Ray Chaudhuri *et al.,* 2000). The present study was undertaken to make a classificatory analysis on the rice genotypes by means of PCA.

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## Materials and Methods

Fifty rice genotypes of different eco-geographic were collected from the Department of Plant Genetic Resources, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, India. The crop was raised in randomized block design, replicated thrice. Each genotype was grown in two rows plot of size 3 m length. A spacing of 20×15 cm was adopted. The crop was raised during Kuruvai (2018) and Samba (2018). Eleven different agronomic traits were observed. Analysis of variance using descriptive statistics such as mean, standard deviation and coefficient of variation for each of the eleven traits were calculated. In order to identify the patterns of variation in agronomic traits, PCA was conducted, the PCA was computed using the following equation:

PCA

$PC\ 1\ \underline{\underline{P}}\ S_1\ a\ j\ '\ j$

Where,

PC = Principal component,

a1j = Linear coefficient – Eigen vectors,

Statistical analyses were performed with Indo-state, licensed at NRRI, Cuttack, Odisa.

## Results and Discussion

The analysis of variance for means indicated that the differences among the genotypes were significant for all the 13 traits of interest (Table 1). The result is in corroboration with the findings of Bharadwaj *et al.,* (2001); Kutaiah *et al.,* (1986) and Maji and Shaibu (2012). It indicated the necessity to group the rice genotypes in to divergent clusters. In rice breeding, the earliness to attain flowering cycle from 18.33 days after transplanting is a good trait that could be utilized for screening drought tolerance genotype.

The PCA was used to eliminate redundancy in the data set. Three principal components accounted for must of the variability observed among the rice germplasm collections from different geographical locations in S1 (Table 2). Principal component 1 accounted for 79 per cent of the morphological variation in the rice germplasm collection and was loaded on days to 50 per cent flowering and harvest index (%). Principal component 2 accounted for about six per cent of the total morphological variation and was loaded on number of filled grains per panicle, length of seeds and length; breadth ratio of seeds. The remaining variables had weak or no discriminatory power. Thus the most important descriptors were those associated with principal component 1 and 2.

In S2, principal component 1 accounted for about 69 per cent of the morphological variation in the rice germplasm collection and was loaded on days to 50 per cent flowering, length of seeds and harvest index. Principal component 2 account for about nine per cent of the total morphological variation and was loaded on length of seeds and seed yield per plant. The remaining variables had weak or no discriminatory power. Thus, the most descriptors were those associated with principal component 1 and 2 (Table 3).

**Table 1:** Analysis of variance.

| Traits | Mean squares | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Replication df=2 | | | Genotypes df=49 | | | Error df=98 | | |
| | S1 | S2 | Pooled analysis | S1 | S2 | Pooled analysis | S1 | S2 | Pooled analysis |
| Days to 50% flowering | 01.36 | 2.5466 | 1.02 | 1422.49** | 1581.01** | 1720.05** | 0.78 | 1.1779 | 0.8721 |
| Plant height (cm) | 34.99 | 57.41* | 41.60 | 1035.72** | 957.78** | 990.81* | 19.55 | 16.08 | 14.08 |
| Total number of tillers per plant | 34.07 | 17.76 | 24.66 | 168.92** | 129.36** | 142.71** | 16.45 | 19.96 | 17.19 |
| Number of productive tillers per plant | 06.13 | 01.67 | 02.86 | 88.04** | 65.84** | 70.34** | 04.89 | 3.24 | 3.13 |
| Panicle length (cm) | 07.06 | 01.86 | 0.44 | 34.50** | 27.83** | 29.10** | 04.08 | 3.54 | 2.82 |
| Number of filled seeds/panicle | 69.85 | 06.66 | 11.11 | 6695.24** | 5974.82** | 6267.47** | 92.56 | 244.42 | 125.75 |
| Length of seeds (mm) | 00.03 | 00.02 | 0.02 | 1.90** | 2.0112** | 1.68** | 00.01 | 0.01 | 0.01 |
| Breadth of seeds (mm) | 0.00009 | 00.004 | 0.004 | 0.2553** | 0.4411** | 0.33** | 0.0059 | 0.003 | 0.002 |
| Length/breadth ratio of seeds | 0.0096 | 00.02 | 0.002 | 1.1649** | 1.2266** | 1.19** | 0.0146 | 0.01 | 0.01 |
| 100 Seed weight (g) | 0.0552 | 0.01 | 0.09** | 0.9458** | 0.9772** | 0.91** | 0.0229 | 0.01 | 0.009 |
| Total dry matter production/plant (g) | 3.5698 | 13.77 | 1.52 | 1713.30** | 1041.11** | 1312.13** | 37.30 | 14.48 | 18.77 |
| Seed yield/plant (g) | 2.0934 | 03.43 | 0.20 | 725.86 | 1028.17** | 704.56** | 8.2583 | 4.87 | 4.25 |
| Harvest index (%) | 4.0667 | 16.32 | 1.03 | 629.58 | 522.90** | 532.79** | 13.2426 | 10.05 | 7.59 |

*Significant at P=5% ; **Significant at P=1%

**Table 2:** Eigen value and per cent of total variation and component matrix for the principal component axes in Season 1.

| **Principal components** | **1** | **2** | **3** |
|---|---|---|---|
| Eigen value | 11375.30 | 844.79 | 696.63 |
| Percentage of variance | 79.26 | 5.89 | 4.85 |
| Cumulative (%) | 79.26 | 85.15 | 90.00 |
| **Component matrix** | | | |
| Days to 50% flowering | 0.95103 | 0.05030 | 0.04601 |
| Plant height at maturity (cm) | -0.08376 | 0.15474 | 0.41421 |
| Total number of tillers per plant | -0.09106 | 0.02970 | 0.11737 |
| Number of productive tillers per plant | 0.07724 | 0.01151 | 0.11987 |
| Length of primary panicle length (cm) | -0.01535 | 0.11402 | 0.10139 |
| Number of grains per panicle | -0.09321 | 0.31081 | 0.68646 |
| Length of seeds (mm) | 0.04531 | 0.74487 | -0.38235 |
| Breadth of seeds (mm) | -0.00475 | -0.32762 | -0.06712 |
| L/B ratio of seeds | 0.00506 | 0.41043 | -0.00450 |
| Weight of hundred seeds (g) | 0.05096 | -0.04568 | -0.14654 |
| Total dry matter production per plant (g) | 0.14562 | -0.02672 | 0.33976 |
| Seed yield per plant (g) | 0.00807 | -0.03797 | 0.04626 |
| Harvest index (%) | 0.19841 | -0.16744 | 0.16401 |

**Table 3:** Eigen value and per cent of total variation and component matrix for the principal component axes in Season 2.

| **Principal components** | **1** | **2** | **3** |
|---|---|---|---|
| Eigen value | 11041.17 | 1421.89 | 1163.29 |
| Percentage of variance | 68.53 | 8.83 | 7.22 |
| Cumulative (%) | 68.53 | 77.36 | 84.58 |
| **Component matrix** | | | |
| Days to 50% flowering | 0.81560 | 0.08282 | 0.34377 |
| Plant height at maturity (cm) | -0.06020 | -0.03314 | 0.27168 |
| Total number of tillers per plant | -0.10539 | -0.03262 | 0.02208 |
| Number of productive tillers per plant | -0.05940 | -0.04956 | 0.02535 |
| Length of primary panicle length (cm) | -0.05761 | 0.04063 | 0.04819 |
| Number of grains per panicle | -0.08784 | 0.00113 | 0.23077 |
| Length of seeds (mm) | 0.24153 | 0.73821 | -0.20422 |
| Breadth of seeds (mm) | 0.12894 | -0.39333 | -0.36101 |
| L/B ratio of seeds | -0.34143 | 0.13226 | 0.22145 |
| Weight of hundred seeds (g) | 0.13451 | -0.25562 | 0.03459 |
| Total dry matter production per plant (g) | -0.03725 | -0.04339 | 0.63834 |
| Seed yield per plant (g) | 0.05796 | 0.27878 | -0.27870 |
| Harvest index (%) | 0.30155 | -0.35322 | -0.20979 |

**Table 4:** Eigen value and per cent of total variation and component matrix for the principal component axes in pooled analysis.

| **Principal components** | **1** | **2** | **3** |
|---|---|---|---|
| Eigen value | 1178.43 | 1934.86 | 1000.25 |
| Percentage of variance | 69.12 | 11.35 | 5.87 |
| Cumulative (%) | 69.12 | 80.47 | 86.34 |
| **Component matrix** | | | |
| Days to 50% flowering | 0.90457 | 0.00885 | 0.23621 |
| Plant height at maturity (cm) | -0.06846 | 0.00349 | 0.32697 |
| Total number of tillers per plant | -0.10418 | -0.01127 | 0.04356 |
| Number of productive tillers per plant | -0.01300 | -0.03579 | 0.05238 |
| Length of primary panicle length (cm) | -0.06909 | 0.05654 | 0.05918 |
| Number of grains per panicle | -0.08675 | 0.03647 | 0.36960 |
| Length of seeds (mm) | 0.14514 | 0.81323 | -0.35903 |
| Breadth of seeds (mm) | 0.01885 | -0.38381 | -0.42312 |
| L/B ratio of seeds | -0.09926 | 0.33285 | 0.11113 |
| Weight of hundred seeds (g) | 0.12028 | -0.01302 | 0.20638 |
| Total dry matter production per plant (g) | 0.10945 | -0.07700 | 0.41181 |
| Seed yield per plant (g) | -0.09888 | -0.05208 | -0.12610 |
| Harvest index (%) | 0.29368 | -0.25637 | -0.37972 |

In the pooled analysis, principal component 1 accounted for 69 per cent of the morphological variation in the rice germplasm collection and was loaded on days 50 per cent flowering and harvest index. Principal component 2 accounted for 11 per cent of the morphological variation in the rice germplasm collection and was loaded on length of sees. The remaining variables had weak or no discriminatory power. Thus, the must important descriptors were those associated with principal component 1 and 2.

The result amply indicated that the most important descriptors were those associated with principal component 1 and 2. It would be useful in evaluating the potential breeding value of the rice germplasm.

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