SHORT COMMUNICATION

# Factor Analysis of Components of Yield and some Growth Parameters in Urdbean (*Vigna mungo* (L.) Hepper)

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Factor analysis was carried out on 64 genotypes of urdbean to assess the extent of variation for different characters. Data collected on seventeen quantitative traits were subjected to Principal Factor analysis. There were only seven factors which accounted for maximum percentage to the total variance. In factor one about 50 percent variation was associated with grain yield, harvest index, pods/plant, pod bearing branches/plant, plant height, leaf area and leaf growth rate. Factor 2 accounted almost 20% variation and traits included were harvest index and net assimilation rate. Factor 3, 4, 5 and 7 contained variation for some physiological traits including few yield component characters.

**Key Words: Factor analysis, Growth traits, Multivariate analysis, Urdbean, Yield traits**



Urdbean (*Vigna mungo* (L.) Hepper) is an important self-pollinating diploid (2n=2x=22) crop. It forms a significant component of the dietary requirement of people in India. The factor component analysis indicate the extent of genetic diversity of germplasm accessions based on the evaluated characters. Further, univariate statistical analysis are not adequate as they ignore the correlation among the variables and sometimes the conclusion may be misleading, while the multivariate analysis technique taking into account the interdependence and relative importance of various characters involved yield more meaningful genetic information. The aim of multivariate analysis is to reduce the number of variables by employing suitable linear transformation and to choose a few linear combinations in some optimum manner. However, minor genes, whose effects could be identified by plant morphology, have been exploited for the genetic improvement of urdbean, but this has not led to major gains in the yield potential. The analysis of constraints to increasing genetic potential of these crops reveals the existence of wide difference between the actual biological potential and the highest levels achieved through the present available base. However, the selection of diverse parents and desirable traits belonging to distant sources also led to a wide spectrum of gene and gene-combinations for morpho-physiological traits. In determining the potential of genetically different lines and cultivars, breeders have to observe many different characters that influence yield. Accurate evaluation of these characters is made difficult by the genotype-environment interaction. This study was undertaken in order to determine the dependence relationship between yield components and some physiological traits of several genotypes of urdbean using factor analysis.

The genetic materials for the present investigation consist of 64 genotypes (promising accessions and some advance breeding lines) included in the study. These genotypes were evaluated for their performance at the Regional Research Station, Himachal Pradesh Agricultural University, Bajaura ($31^0$ 48' N, $77^0$00 E, 1099 msl). The experiment was conducted in Randomized Block Design with three replications under rainfed conditions. Data were recorded on ten randomly selected plants/replication on $X_1$= seed yield/plant (g), $X_2$= harvest index (%), $X_3$= 100-seed weight (g), $X_4$= seeds/pod, $X_5$= pods/plant, $X_6$= biological yield/plant (g), $X_7$= plant height (cm), $X_8$ = pod bearing branches/plant, $X_9$ = days to 50% flowering, $X_{10}$= days to maturity, $X_{11}$= leaf area/plant, $X_{12}$= crop growth rate (g day-$^1$), $X_{13}$= leaf growth rate (cm$^2$ day-$^1$), $X_{14}$= net assimilation rate (mg dm-$^2$), $X_{15}$= specific leaf weight (mg day-$^1$), $X_{16}$= leaf area ratio (dm-$^2$ g-$^1$) and $X_{17}$= leaf weight ratio. Estimates of factor loadings were based on data from all replications for all populations. Factor analysis calculations were performed using SPSS factor analysis programme. Simple correlation coefficients were calculated for 17 characteristics of 64 genotypes. Thus factor analysis is a multivariate analysis method which aims to explain the correlation between a large set of variables in terms of a small number of underlying

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independent factors. It is assumed that each of the variables measured, depends upon the underlying factors but is also subject to random errors. The principal factor analysis method explained by Harman (1976) was followed in the extraction of the factor loadings. The array of communality, the amount of the variance of a variable accounted by the common factors together, was estimated by the highest correlation coefficient in each array as suggested by Seiller and Stafford (1985). The number of factors was estimated using the maximum likelihood method of Rao (1952). The varimax rotation method (an orthogonal rotation) was used in order to make each factor uniquely defined as a distinct cluster of inter correlated variables (Rao, 1952). The factor loadings of rotated matrix, the percentage variability explained by each factor and the communalities for each variable were determined. The results obtained on principal factor matrix of the present investigation have been presented below.

The total variance explained by factors is indicated in Table 1. Only the first seven factors which account for almost 75% of the total variance are important. A principal factor matrix after orthogonal rotation for these seven factors given in Table 2. The values in the table, or loadings, indicate the contribution of each variable to the factors. For the purpose of interpretation only those factor loadings greater than 0.5 were considered important, these values are highlighted in the bold in Table 2. Factor 1, which accounted for about 50% of the variation, was strongly associated with seed yield, harvest index, pods/plant, biological yield/plant, plant height, pod bearing branches/plant, leaf area/plant and leaf growth rate. This factor was regarded as productivity/plant factor, since it included several traits which are component of yield including some desirable growth traits. All majority of variables had positive loadings in factor 1. The sign of the loading indicates the direction of the relationship between the factor and the variable. Factor 2, which account for about 20% of the variation was named a reproductive (fertility) factor since it contained the harvest index, days to flowering and net assimilation rate which are associated with fertility. Again all these variables had positive loadings. The third factor was named as efficiency factor since it consisted leaf area/plant and leaf growth rate. This of course indicates the efficiency of the plant to convert the available resource into economic produce. Factors 3, 4, 5 and 7 also accounts for variation, since it consisted some growth parameters and couple of yield traits. Likewise, factor 6 does not contain any positive loading to be considered in the selection. Seiller and Stafford (1985) indicated that seeds/pod and 100-seed weight regarded as yield/unit area factor in the guar crop. However, in this study 100-seed weight was not included in any of the factors since it had very low loadings (less than 0.50). Seeds/pod were regarded as an economic factor in cluster bean by Rao and Paroda (1982). In this study, however factors grouped with the desirable phenological, yield components and physiological traits (factor 1 and 2). This study indicating that selection of variables in the productivity/plant and reproductive factor could enable breeders to select better genotypes/traits for desired increment in seed yield of urdbean. It is also expected that knowledge of the groups and sub-groups identified may be used to breed new genotypes for specific purposes. Assembling of the accessions provides preliminary answer to the identification of parental lines and specific characters for future urdbean breeding programmes. Similar observations were also reported by Walton (1991), Woldeamlak and Alelign (2007) and Ramesh *et al.* (2011).

**Table 1. Total variance explained for each factor based on 17 different characters in 64 urdbean genotypes**

| Factor | % of variance | Cumulative % |
|---|---|---|
| 1 | 21.89 | 21.89 |
| 2 | 13.50 | 34.88 |
| 3 | 11.67 | 46.55 |
| 4 | 8.09 | 54.65 |
| 5 | 7.10 | 61.75 |
| 6 | 6.62 | 68.35 |
| 7 | 5.90 | 74.88 |
| 8 | 5.21 | 79.48 |
| 9 | 4.89 | 84.32 |
| 10 | 4.40 | 88.70 |
| 11 | 3.56 | 92.45 |
| 12 | 3.70 | 95.85 |
| 13 | 1.90 | 97.76 |
| 14 | 1.47 | 99.20 |
| 15 | 0.60 | 99.80 |
| 16 | 0.30 | 99.92 |
| 17 | 0.23 | 100.00 |

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**Table 2. Principal factor matrix after varimax rotation for 17 characters of 64 genotypes of urdbean. Number in bold are those with factor loadings greater than 0.50**

| Variables | Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Seed yield/ plant | **0.868** | -0.231 | -0.383 | -0.100 | 0.030 | 0.132 | 0.045 |
| Harvest index | **0.599** | **0.747** | 0.242 | 0.122 | 0.032 | 0.348 | 0.263 |
| 100- seed weight | 0.416 | 0.164 | -0.180 | -0.125 | -0.342 | -0.031 | -0.021 |
| Seeds/pod | -0.128 | 0.263 | -0.425 | -0.051 | **0.547** | 0.421 | 0.193 |
| Pods/ plant | **0.785** | -0.463 | -0.090 | -0.017 | -0.129 | -0.035 | 0.145 |
| Biological yield /plant | **0.732** | 0.392 | -0.422 | -0.098 | 0.036 | -0.087 | 0.032 |
| Plant height | **0.534** | 0.374 | -0.036 | -0.311 | 0.054 | -0.026 | 0.208 |
| Pod bearing branches/plant | **0.706** | -0.471 | -0.051 | -0.333 | 0.035 | -0.012 | -0.042 |
| Daya to 50% flowering | 0.214 | **0.622** | 0.122 | 0.480 | 0.008 | 0.244 | -0.190 |
| Days to maturity | 0.106 | 0.236 | -0.399 | 0.031 | 0.067 | -0.103 | 0.329 |
| Leaf area/plant | **0.547** | 0.138 | **0.746** | 0.032 | 0.287 | -0.098 | -0.034 |
| Crop growth rate | 0.277 | -0.102 | 0.153 | 0.080 | -0.329 | -0.076 | -0.123 |
| Leaf growth rate | **0.551** | 0.160 | **0.754** | -0.421 | 0.259 | -0.023 | 0.024 |
| Net assimilation rate | -0.055 | **0.501** | 0.233 | 0.065 | -0.296 | 0.223 | **0.611** |
| Specific leaf weight | -0.121 | 0.272 | 0.149 | 0.080 | -0.225 | -0.023 | 0.106 |
| Leaf area ratio | -0.056 | -0.106 | -0.089 | **0.677** | **0.603** | 0.252 | 0.231 |
| Leaf weight ratio | 0.116 | 0.158 | -0.061 | 0.432 | -0.031 | 0.342 | -0.025 |



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