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Using Cluster Analysis and Principal Component Analysis to Group Lines and Determine Important Traits in White Bean

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Abstract

Beans due to having a high protein are important in food regime in developing countries including Iran. Beans are planted on five continents of the world and its cultivated area is 36148114 hectare all over the world. The cultivated area of this crop in Iran is 98000 hectare and its production is 253000 ton (FAO, 2013). One of the most important methods to increase quality and quantity of agricultural products is plant breeding. Selection is the basic stage of plant breeding and applying it required evaluating available germplasm. The fundamental method to develop variation for selection is crossing genotypes where selecting the parents may be very important and existing genetic differences between the crossing parents be required. Grouping the genotypes can make the opportunity to the breeder so that can select appropriate parents for crossing. The aims of the present research were to group 45 lines of white bean and to determine their important traits in order to explain their differences. To do this the lines evaluated in a randomized complete block design with three replications on the research farm of University of Zanjan. Protein content and nine agronomic traits were evaluated. Genotypes divided in 4 groups by cluster analysis among which the genotypes of the fourth group were superior in terms of all traits. Based on principal component analysis the first three principal components were selected that were justified 70% of total variations. Grouping of lines in biplots had much more conformity with the results from dendrogram and showed more importance of the first principal component, which justifies much of total variance. As a result, grain yield, biomass, number of seed per pod, and stem diameter can be recommended as the most important traits to select lines of white bean.

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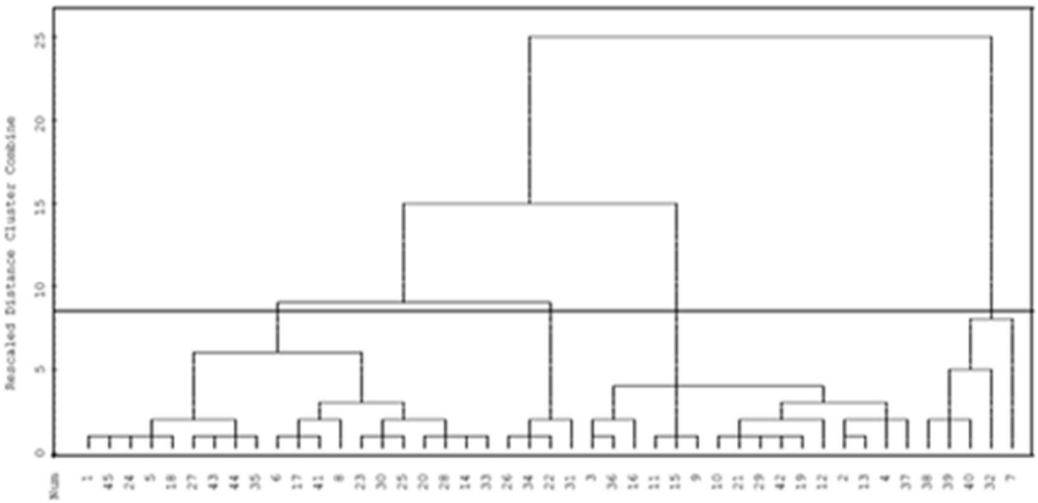

Figure 1: Dendrogram for 45 genotypes of bean in ward method

Table 1. Eigen Vectors, Eigenvalues, Variation Explained (%) and Cumulative Variance (%) of the First Three Principal Components Related to the Studied Traits in 45 Genotypes of White Bean

Principal components and coefficient of determination						
Traits	**The first component**	**r^2**	**The second component**	**r^2**	**The third component**	**r^2**
Protein content (%)	0.003	0.000	0.103	0.017	-0.073	0.006
Grain yield per plant	0.376	0.604	-0.305	0.148	-0.212	0.051
Biomass per plant	0.449	0.861	-0.127	0.026	-0.234	0.063
Number of pods per plant	0.302	0.390	-0.558	0.496	0.046	0.002
Number of seeds per pod	0.340	0.494	-0.238	0.090	-0.060	0.004
100-seed weight	0.238	0.242	0.460	0.337	0.234	0.063
Seed dense	0.271	0.314	0.137	0.030	0.650	0.482
Pod length	0.314	0.421	0.450	0.323	-0.123	0.017
Plant height	0.272	0.316	0.144	0.033	0.585	0.391
Stem diameter	0.385	0.633	0.242	0.093	-0.234	0.063
Eigenvalue	4.273	-	1.593	-	1.142	-
Variation explained (%)	42.733	-	15.929	-	11.424	-
Cumulative variance (%)	42.733	-	58.662	-	70.087	-

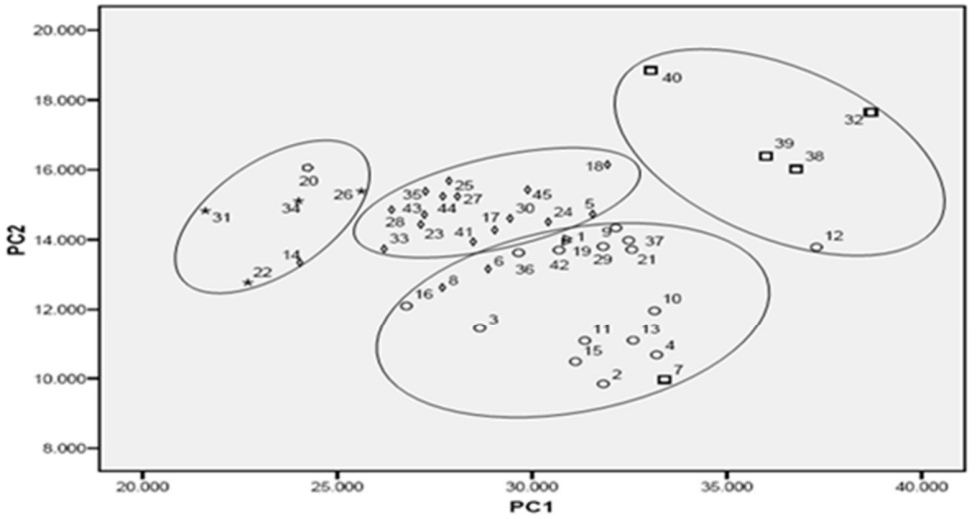

Figure 2- Biplot of the first and second principal components
(◊= first cluster; *= second cluster; ◦ = third cluster; □= fourth cluster genotypes)

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Keywords: Biplot, Grouping; Multivariate analysis; *Phaseolus vulgaris*; Selection

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