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Principal component analysis in mungbean [*Vigna radiata* L. Wilczek] genotypes under two seasons

Shruti Paliwal, Stuti Sharma and Nidhi Pathak

Abstract
To find out the promising genotypes of mungbean which have maximum yield and can be grown in both seasons i.e. *kharif* and *zaid* we conducted this present investigation of sowing 60 mungbean genotypes in both growing seasons and pooled the result to obtain maximum high yielding genotypes through Principal Component Analysis (PCA). In *kharif* analysis only five principal components (PCs) exhibited more than 1.00 Eigen value, and showed about 77.64% variability among the traits studied. During *zaid* analysis six principal components (PCs) exhibited more than 1.00 Eigen value, and showed about 81.56% variability among the traits studied. In Pooled analysis only five principal components (PCs) exhibited more than 1.00 Eigen value, and showed about 70.70% of variability among the traits studied. Rotated component matrix revealed that the PC1 which accounted for the highest variability (19.146%) was mostly related with traits such as hundred seed weight, Harvest Index, seed yield per plant (g).

Keywords: *Zaid*, *Kharif*, Rotated component matrix, principal component analysis, mungbean

1. Introduction
Mungbean or green gram [*Vigna radiata* L. Wilczek] is a major legume crop grown in India and Southeast Asia. This is the most popular legume in India because of its good platability, nutritional quality and easy digestibility (Tripathi *et al*, 2020) [8]. It is a short duration crop which rapidly completes it vegetative phase followed by reproductive phase, hence can be grown in between seasons to earn maximum profit. The nutritional quality of crop makes it an important pulse crop and it is necessary to find out the best growing cultivar suited for all season. In this present investigation we are trying to find out the best genotype which can be grown in both season to give maximum yield and benefit. For this we have used Principal Component Analysis as a tool to find out the traits which contribute most to the yield and most promising genotypes for maximum yield. This investigation is conducted with 60 mungbean genotype for the characters *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of pod cluster per plant, number of pods per plant, plant height, number of seeds per pod, pod length, 100 seed weight, biological yield per plant, harvest index per plant and seed yield per plant to identify the promising genotype using PCA.

2. Material and Methods
This present investigation was carried out at two locations, for kharif at Vegetable Seed Production Unit Maharajpur College of Agriculture JNKVV Jabalpur in 2020 and at Breeder Seed Production unit Adhartaal, College of Agriculture JNKVV Jabalpur during 2021. For this experiment sixty mungbean genotypes were grown using Randomized Complete Block Design, maintaining row to row distance of 30 cm and plant to plant distance of 10 cm. The recommended cultural practices and plant protection practices were followed to reduce experimental error and maintain healthy plant stand. Data were recorded on five randomly selected plants of each genotype for the characters *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of pod cluster per plant, number of pods per plant, plant height, number of seeds per pod, pod length, 100 seed weight, biological yield per plant, harvest index per plant and seed yield per plant. The mean value of data was subjected to statistical analysis to obtain analysis of variance (Panse and Sukhatme, 1985) [4]. Principal component analysis is helpful tool in modern data analysis for the genetic improvement of important traits rather than selecting all the characters under study and the contribution of each component to the total variation. It was calculated using Massay and Jolliffie (1986) [3] method.

3. Result and Discussion

In this present study PCA was performed for variable traits and traits contributing towards yield with 60 mungbean genotypes. In *kharif* analysis it revealed that out of twelve, only five principal components (PCs) exhibited more than 1.00 Eigen value, and showed about 77.64% variability among the traits studied (table 1). Hence, these five principal components were given due importance for the further explanation. Scree plot (fig 1) was obtained by plotting a graph between Eigen value and principal component number which explains the percentage of variance associated with each principal components (PCs). The PC1 had the highest variability 18.13% followed with PC2 (17.47%), PC3 (12.98%), PC4 (10.94%), PC5 (9.75%) for traits under study. Maximum variation was found in first PC; therefore selection for traits under first PC may be desirable. Rotated component matrix (table 2, 3) revealed that the PC1 which accounted for the highest variability (18.13%) was mostly related with days to 50% flowering, days to maturity and 100 seed weight. In PC2 (17.41%) was mostly related with biological yield per plant, 100 seed weight, seed yield per plant (g). In PC3 (12.9%) related with days to maturity, number of primary branches per plant, harvest index (%).In PC4 (10.90%) related with days to maturity number of pod per plant, pod length (cm), 100 seed weight (g). In PC5 (9.75%) was related with harvest index. Based on top PC scores; promising genotypes were categorized in the table 4. Genotype showing maximum positive PC scores and common in PC1, PC2 and PC4 is VGG 17-015 and common in PC1 and PC4 is VGG 17-015 and Pusa Vishal, while common in PC2 and PC3 is SPM 20-59, common in PC1 and PC3 is WBSM 48-5 for the traits *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of pod cluster per plant, number of pods per plant, pod length, number of seeds per pod, hundred seed weight, harvest Index, biological yield per plant and seed yield per plant.

In *Zaid* analysis it revealed that six principal components (PCs) exhibited more than 1.00 Eigen value, and showed about 81.56% variability among the traits studied(table 5). Hence, these six principal component were given due importance for the further explanation. Rotated component matrix (Table 6,7) revealed that PC1 which accounted for the highest variability (20.65%), was mostly related with number of pod cluster per plant, number of pods per plant, number of seeds per pod, hundred seed weight, harvest index, seed yield per plant. In PC2 the variability was mostly related with days to 50% flowering, days to maturity, biological seed yield per plant. In PC3 the traits of most concern are number of pods per plant, biological seed yield per plant, seed yield per plant. In PC4 traits of concern are pod length, number of seeds per pod, biological yield per plant. In PC5 the traits of concern are plant height and pod length. In PC6 trait of concern is number of primary branches per plant. Based on top PC scores; promising genotypes were categorized in the table 8. Genotype showing maximum positive PC scores and common in PC1 and PC2 is LGG 460 and common in PC1 and PC3 is HUM-1 for the traits *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of pod cluster per plant, number of pods per plant, pod length, number of seeds per pod, hundred seed weight, harvest Index, biological yield per plant and seed yield per plant.

In pooled analysis it helped us to determine that only five principal components (PCs) exhibited more than 1.00 Eigen value, and showed about 70.70% of variability among the traits studied(table 9). Hence these five principal components were given due importance for the further explanation. Rotated component matrix (Table 10, 11) revealed that the PC1 which accounted for the highest variability (19.146%) was mostly related with traits such as hundred seed weight, Harvest Index, seed yield per plant (g). PC2 was mostly related with traits such as days to 50% flowering, days to maturity. PC3 was mostly related with number of pods per plant, pod length, number of seeds per pod, biological yield per plant, seed yield per plant. PC4 was mostly related with biological yield per plant and seed yield per plant. PC5 was mostly related with number of primary branches per plant and number of seeds per pod. Based on top PC scores; promising genotypes were categorized in the table 12. Genotype showing maximum positive PC scores and common in PC1 and PC3 is VGG 17-015 and common in PC1 and PC5 is TRCM 147 for the traits *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of pod cluster per plant, number of pods per plant, pod length, number of seeds per pod, hundred seed weight, harvest Index, biological yield per plant and seed yield per plant.

Similar findings have been reported by Perera *et al.* (2017) [5] for plant height, seeds per pod and pod length Thippani *et al.* (2017) [7] for pod length, 100-seed weight and number of primary branches, Jhakar *et al.* (2018) [1] for biological yield accounted for most variability in the mungbean genotypes, Thippani *et al.* (2017) [7] found that first five principal components accounted for 78.78% of the total variation. Jhakar *et al.* (2018) [1] investigated thirty greengram germplasm accessions and reported four principal components. Tahir *et al.* (2020) [6] evaluated 533 accessions of Mungbean for qualitative and quantitative traits.

Table 1: Eigen values, Percentage of total variation and cumulative percentage for corresponding 12 traits in Mungbean genotypes in *kharif*

Traits	Principal Components	Eigen values	Variability %	Cumulative %
Days to 50% flowering	PC1	2.177	18.139	18.139
Days to maturity	PC2	2.096	17.471	35.609
Plant height	PC3	1.558	12.982	48.592
Number of primary branches per plant	PC4	1.308	10.904	59.496
Number of pod cluster per plant	PC5	1.170	9.750	69.245
Number of pods per plant	PC6	0.893	8.365	77.611
Pod length	PC7	0.876	7.300	84.910
Number of seeds per pod	PC8	0.606	5.053	89.963
100 seed weight	PC9	0.557	4.641	94.604
Biological yield per plant	PC10	0.494	4.120	98.724
Harvest index	PC11	0.131	1.088	99.812
Seed yield per plant	PC12	0.023	0.188	100.000

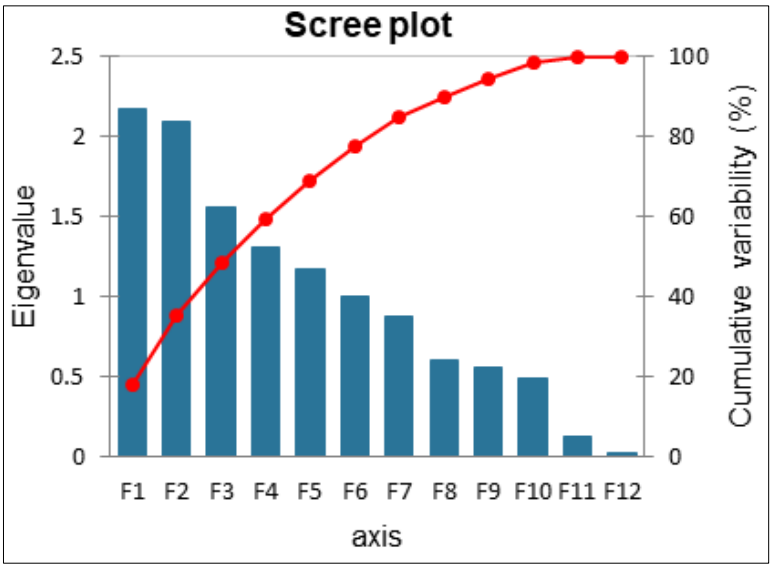

Fig 1: Scree plot constructed using 12 PCs for *kharif*

Table 2: Principal Components for 12 yield contributing traits of mungbean genotypes under *kharif* season

Traits	Principal components				
	PC1	PC2	PC3	PC4	PC5
Days to 50% flowering	0.848	-0.102	0.276	0.319	0.101
Days to maturity	0.768	-0.224	0.325	0.387	-0.066
Plant Height	-0.340	-0.562	-0.014	0.091	-0.428
Number of primary branches per plant	-0.032	-0.461	0.336	-0.075	-0.181
Number of pod cluster per plant	-0.300	-0.503	-0.374	0.352	-0.253
Number of pod per plant	-0.089	-0.493	-0.319	0.538	0.186
Pod length (cm)	-0.144	0.250	0.111	0.430	-0.470
Number of seeds per plant	-0.079	-0.241	-0.447	0.172	0.646
Biological yield per plant (g)	-0.282	0.463	0.034	0.217	-0.164
Harvest index (%)	-0.570	-0.070	0.686	0.237	0.337
100 seed weight (g)	0.299	0.584	-0.544	0.235	-0.165
Seed yield per plant(g)	-0.363	0.574	0.205	0.507	0.185

Table 3: Interpretation of rotated component matrix for the traits having high values in each PC under *kharif* season

	PC1	PC2	PC3	PC4	PC5
Traits	Days to 50% flowering	Biological yield per plant (g)	Days to maturity	Days to maturity	Harvest index (%)
	Days to maturity	100 seed weight (g)	Number of primary branches per plant	Number of pod per plant	
	100 seed weight(g)	Seed yield per plant (g)	Harvest index (%)	Pod length (cm)	
				100 seed weight (g)	

Table 4: List of selected genotypes in each principal component under *kharif* analysis

MM 1451	IPM 02-3	SPM 20-59	VGG 17-015	PUSA M1941
VGG 17-015	VGG 17-015	WBSM 48-5	VGG-460	SML 1831
TMB-37	SL-688	IPM 205-7	PUSA VISHAL	VGG 16-045
VGG 460	IPM 610-2	IPM 410-3		
PUSAVISHAL	SPM 20-59			
GANGA 8				
WBSM 48-5				

Table 5: Eigen values, Percentage of total variation and cumulative percentage for corresponding 12 traits in mungbean genotypes under Z*aid* season

Traits	Principal component	Eigen values	Variability %	Cumulative %
Days to 50% flowering	PC1	2.479	20.654	20.654
Days to maturity	PC2	2.177	18.144	38.798
Plant height (cm)	PC3	1.511	12.592	51.390
Number of primary branches per plant	PC4	1.431	11.922	63.311
Number of pod cluster per plant	PC5	1.171	9.757	73.068
Number of pod per plant	PC6	1.020	8.497	81.565
Pod length (cm)	PC7	0.937	7.805	89.370
Number of seeds per pod	PC8	0.605	5.042	94.412

100 seed weight (g)	PC9	0.388	3.236	97.648
Biological yield per plant (g)	PC10	0.157	1.310	98.957
Harvest Index (%)	PC11	0.090	0.754	99.711
Seed yield per plant(g)	PC12	0.035	0.289	100.000

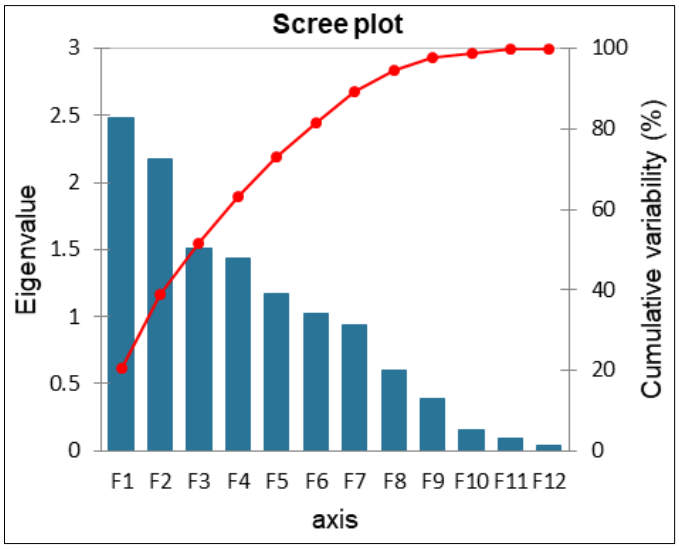

Fig 2: Scree plot constructed using 12 PCs under *Zaid* season

Table 6: Principal Components for 12 yield contributing traits of mungbean in Rotated Component Matrix under *Zaid* season

Traits	Principal components					
	PC1	PC2	PC3	PC4	PC5	PC6
Days to 50% flowering	0.275	0.786	-0.337	-0.352	0.106	-0.031
Days to maturity	0.227	0.808	-0.303	-0.287	0.196	-0.144
Plant height (cm)	-0.377	-0.219	0.160	-0.149	0.655	-0.208
Number of primary branches per plant	0.118	-0.274	-0.179	0.025	0.309	0.688
Number of pod cluster per plant	0.398	0.252	0.140	0.094	-0.601	0.282
Number of pod per plant	0.593	0.228	0.587	-0.052	0.312	0.214
Pod length (cm)	0.285	0.142	-0.300	0.717	0.317	0.070
Number of seeds per pod	0.429	-0.075	-0.474	0.580	0.051	-0.192
100 seed weight (g)	0.375	-0.369	-0.036	-0.022	-0.132	-0.517
Biological yield per plant (g)	-0.271	0.510	0.557	0.467	0.030	-0.159
Harvest Index (%)	0.737	-0.490	-0.141	-0.347	0.065	-0.041
Seed yield per plant(g)	0.814	-0.068	0.487	0.042	0.109	-0.140

Table 7: Interpretation of rotated component matrix for the traits having high values in each PC under *Zaid* season

	PC1	PC2	PC3	PC4	PC5	PC 6
Traits	Number of pod cluster per plant	Days to 50% flowering	Number of pod per plant	Pod length (cm)	Plant height (cm)	Number of PB per plant
	Number of pod per plant	Days to maturity	Biological yield per plant (g)	Number of seeds per pod	Pod length (cm)	-
	Number of seeds per pod	Biological yield per plant (g)	Seed yield per plant(g)	Biological yield per plant (g)	-	-
	100 seed weight (g)	-	-	-	-	-
	Harvest Index (%)	-	-	-	-	-
	Seed yield per plant(g)	-	-	-	-	-

Table 8: List of selected genotypes in each principal component under *Zaid* season

PC1	PC2	PC3	PC4	PC5	PC 6
Ganga 8	Pusa Vishal	SPM 20-61	PUSA M 1942	PUSA M 1943	OBGG 102
SPM 20-69	VGG-460	SPM 20-55	SML 1832	35-SHIKHA	TJM-3
SPM 20-68	TMB-37	SPM 20-56	SPM 20-70	SPM 20-66	VGG 10-045
Hum-1	WBSM 48-5	HUM-1	SPM 20-57	VGG 17015	
IPM 610-2	MM 1344	IPM 701-4			
SML 1831	LGG 460	TMB-136			
LGG 460	MM 1451				

Table 9: Eigen values, Percentage of total variation and cumulative percentage for corresponding 12 traits in mungbean genotypes under pooled analysis

Traits	Principal component	Eigen values	Variability %	Cumulative %
Days to 50% flowering	PC1	2.298	19.146	19.146
Days to maturity	PC2	2.111	17.591	36.738
Plant height (cm)	PC3	1.597	13.305	50.042
Number of primary branches per plant	PC4	1.409	11.744	61.786
Number of pod cluster per plant	PC5	1.027	8.562	70.348
Number of pod per plant	PC6	0.924	7.697	78.046
Pod length (cm)	PC7	0.894	7.448	85.494
Number of seeds per pod	PC8	0.654	5.450	90.944
100 seed weight (g)	PC9	0.573	4.778	95.721
Biological yield per plant (g)	PC10	0.371	3.089	98.810
Harvest Index (%)	PC11	0.093	0.776	99.586
Seed yield per plant(g)	PC12	0.050	0.414	100.000

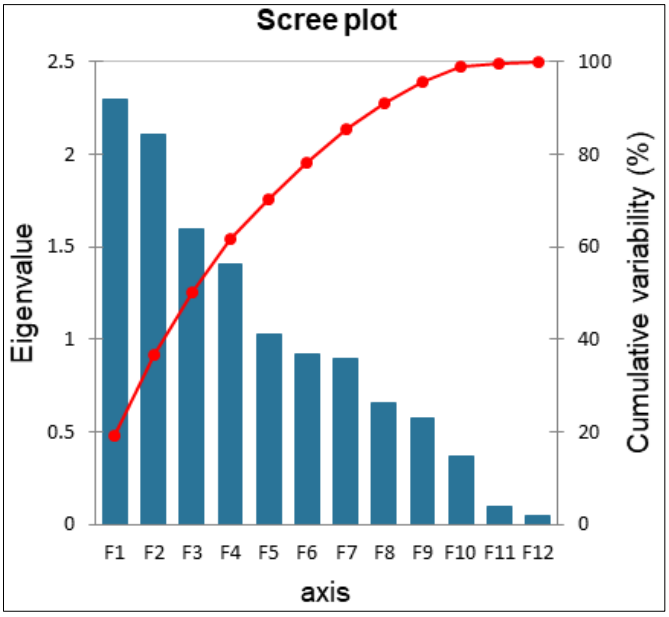

Fig 3: Scree plot constructed using 12 PCs for pooled

Table 10: Principal Components for 12 yield contributing traits of mungbean in Rotated Component Matrix under pooled analysis

Traits	Principal components				
	PC1	PC2	PC3	PC4	PC5
Days to 50% flowering	0.173	0.899	0.252	0.159	-0.070
Days to maturity	0.046	0.877	0.299	0.139	-0.233
Plant height (cm)	-0.702	-0.166	0.007	-0.099	-0.370
Number of primary branches per plant	-0.410	0.181	0.112	-0.254	0.514
Number of pod cluster per plant	-0.562	-0.046	-0.001	-0.427	-0.379
Number of pod per plant	-0.373	0.108	0.518	-0.506	0.078
Pod length (cm)	0.076	-0.055	0.516	-0.112	-0.368
Number of seeds per pod	0.086	-0.061	0.361	-0.456	0.352
100 seed weight (g)	0.460	-0.423	0.151	-0.100	-0.371
Biological yield per plant (g)	-0.493	-0.288	0.507	0.608	0.088
Harvest Index (%)	0.766	-0.035	0.108	-0.425	-0.039
Seed yield per plant(g)	0.310	-0.436	0.689	0.267	0.102

Table 11: Interpretation of rotated component matrix for the traits having high values in each PC under pooled analysis

	PC1	PC2	PC3	PC4	PC5
Traits	100 seed weight (g)	Days to 50% flowering	Number of pod per plant	Biological yield per plant (g)	Number of primary branches per plant
	Harvest Index (%)	Days to maturity	Pod length (cm)	Seed yield per plant(g)	Number of seeds per pod
	Seed yield per plant(g)	-	Number of seeds per pod	-	-
	-	-	Biological yield per plant (g)	-	-
	-	-	Seed yield per plant(g)	-	-

Table 12: List of selected genotypes in each principal component under pooled analysis

PC1	PC2	PC3	PC4	PC5
VGG 17-015	35-SHIKHA	VGG-460	IPM 410-3	HUM-1
IPM 02-3	MM 1451	PDM 139	PUSA M1941	SPM 20-60
TRCM 147	TMB-37	VGG 17-015	VGG 17-015	TRCM 147
SPM 20-59	VGG 16-045	SPM 20-70		
SL-688	PUSA 9531			
IPM 610-2	IPM 205-7			
SPM 20-58				

4. Conclusions

From this present study which was conducted under two seasons i.e. *Kharif* and *Zaid* with sixty Mungbean genotypes, we can conclude that for *Kharif* season the genotypes which turned out to be most promising are VGG 17-015, Pusha Vishal and for *Zaid* season HUM 1 and LGG 460. And the genotypes which proved out to be promising for both the season are VGG 17-015, HUM-1 and TRCM 147. Based on the above conclusion we can use these genotypes accordingly for the season to give maximum yield.

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6. References

1. Jhakhar NK, Arjun K. Journal of Pharmacognosy and Phytochemistry. 2018;7(2):3665-3669.
2. Jolliffe I. Principal component analysis. John Wiley & Sons. Inc. NY. 1986, Pp. 150-165.
3. Massay WF. Principal components regression in exploratory statistical research. Journal of American Statistics Association. 1965;60:234-246.
4. Panse VG, Sukhatme PV. Statistical Methods for Agricultural workers (2ndedition).Indian Council of Agricultural Research, New Delhi, 1985, pg. 381
5. Perera UIP, Chandika KKJ, Ratnasekera D. Genetic variation, character association and evaluation of mungbean genotypes for agronomic and yield components. Journal of the National Science Foundation of Sri Lanka. 2017;45(4):347-353.
6. Tahir A, Ilyas MK, Sardar MM. Selection criteria for yield potential in a large collection of *Vigna radiata* (L.) accessions. Euphytica, 2020, 126-138.
7. Thippani S, Eshwari KB, Bramheshwar MV. Genetic divergence in greengram (*Vigna radiata* (L.) Wilczek). Journal of Progressive Agriculture. 2017;4(2):117-119.
8. Tripathi K, Meena SK, Panwar BS, Lal H, Rana JC, Singh K. Understanding genetic variability in the mungbean (*Vigna radiata* L.) genepool. Annals of Applied Biology. 2020;177(3):346-357.