International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Principal component analysis for assessing phenotypic parameters in brassica rapa var. Brown sarson

Asmat Ara[1], Rehana Mohi ud din[2], Uzma Mehraj[3]

[1,3]Division of Genetics & Plant Breeding (India)

[2] Division of Agronomy (India)

Sher-e-Kashmir University of Agricultural Sciences & Technology of kashmir, Faculty of Agriculture, Sopore

ABSTRACT

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The principal component analysis (PCA), one of Multivariate Analysis methods elucidates among a set of the traits which ones are decisive in genotypic differentiation and selection. The present study was undertaken in rabi 2013-14 at three locations . The collection comprising of 10 genotypes including two checks namely SS-1 and Farmer's variety was studied using factor analysis. Ten quantitative traits related to seed yield namely days to flowering, days to maturity, plant height, primary branches plant^{-1}, length of main raceme (cm), number of siliquae on main raceme, number of siliqua plant^{-1}, number of seeds siliqua^{-1}, 1000-seed weight and seed yield plant^{-1}. Analysis of variance revealed that there were significant differences between checks and accessions, between accessions and between checks for all the traits. It indicated presence of substantial amount of variation among the test entries. The factor analysis was based on Pearson correlation matrix and Euclidean distances. Total variance explained by the first principal component was 67.03% and the variation explained by the second component with 10.6%. Latent roots (Eigen values) are between 6.703 for the first PC and 1.06 for the second PC. Plant height and 1000-seed weight were the important traits in the first principal component. Primary branches per plant and number of siliqua on main raceme were the important traits in second principal component.

Key Words : Genotype, Trait, Variation

I.INTRODUCTION

Brassica rapa L. commonly known as field mustard or turnip mustard belongs to the family Brassicaceae. The seeds of *Brassica rapa* L. contain 42% oil and 25% protein (Khaleque, 1985). It also serves as important source of raw material for industrial use such as in making soaps, paints, hair oils, lubricants, textile auxiliaries, pharmaceuticals and so on. It is the third most important oil crop in the world accounting for over 16% of the world's edible oil supply (Anonymous, 2005). India holds a premier position in rapeseed-mustard economy of the world with 2nd and 3rd rank in area and production respectively. It is the third largest rapeseed-mustard producer in the world after China and Canada with 12 per cent of world's total production (Gupta and Pratap, 2007). It is grown on an area of 5.8 m ha with a production of 6.8 mt and an average productivity of 1.17 t ha^{-1}(Anonymous, 2013). This crop accounts for nearly one third of the oil produced in India, making it the country's key edible oilseed crop after Groundnut and Soybean. This group of oilseed crops is gaining wide acceptance because of adaptibility for both rainfed as well as irrigated areas and suitability for sole as well as mixed cropping. Being a major *rabi* (winter season) oilseed crop, it has greater potential to increase the availability of edible oil from the domestic production. Despite its wide adaptability for varied agro-climatic conditions, the area, production and yield of rapeseed-mustard in India have been fluctuating due to various biotic and abiotic stresses coupled with India's domestic price support programmes. Nevertheless, the crop has a potential to ensure the nutritional security and contribute to livelihood security as well.

In the state of Jammu and Kashmir, brown sarson is the major oilseed crop cultivated on a large scale. During the year 2012-13, the crop was grown on an area of 0.67 lakh ha with a production of 5.32 lakh quintals and an average productivity of 7.94 quintals ha^{-1} (Anonymous, 2013). Not much work has been carried out on genetic improvement of brown sarson. In order to achieve higher production and consequently change the edible oilseed scenario of the state, it is imperative to develop improved varieties with high yielding ability, high oil content and early maturity. Besides yield potential, the variety should also possess stability in its performance over a range of environments. Knowledge on the interaction and stability is foremost in breeding varieties for wider adaptation in adverse agro-climatic conditions. The aim of the breeding programme should be to develop genotypes that can withstand unpredictable transient environmental fluctuations.

The principal component analysis (PCA), one of Multivariate Analysis methods elucidates among a set of the traits which ones are decisive in genotypic differentiation (Kovacic, 1994). PCA enables easier understanding of impacts and connections among different traits by identifying them and explaining their roles. This method is a powerful multiple method to apply evaluation yield component (Guertin and Bailey, 1982), identify biological relationships among traits (Acquaah et al., 1992), decrease associated-traits to a few factors (Johnson and Wichern, 1996) and description of correlations among variables. Factor analysis has the potential of enhancing our knowledge of causal relationship of variables and can help to know the nature and sequences of traits to be selected for breeding program (Khameneh *et al*, 2012).

II.MATERIAL AND METHODS

The study was undertaken in rabi 2013-14 The basic material for the study comprised 10 genotypes of brown sarson (*Brassica rapa* L.). Each genotype was grown in a 3-row experimental plot of 3 metre length with inter and intra row spacing of 30 and 10 cm, respectively across three locations. The plants were space planted for optimal expression of traits and lack of prior knowledge about growth habit of the genotypes. Data was collected from five randomly selected competitive plants on various morphological, maturity, yield and yield contributing traits. The analysis of variance was done using WINDOSTAT advanced biometrics software. We considered ten quantitative traits related to seed yield namely days to flowering, days to maturity, plant height, primary branches plant^{-1}, length of main raceme (cm), Number of siliquae on main raceme, number of siliqua /plant, Number of seeds siliqua^{-1}, 1000-seed weight and seed yield/plant. The factor analysis was based on Pearson correlation matrix and Euclidean distances. Latent roots or Eigen values for all principal components were shown. The variability of the collection in was interpreted based on the seven principal components. Non-rotated and rotated values of Latent vectors (Component weights, Factor loadings) were shown. The Varimax method (Kaiser and Wilkins, 1990) was used for the rotation of principal components. Both the unrotated and the varimex rotated PCA values were calculated by the statistical package statistiXL.

III.RESULTS

Mean performance of the accessions and checks presented in table 1 shows that the means of the traits for days to flowering ranged from 167.6 (KBS-49) to 171.6 (farmer's variety) . Genotypes KBS-69, KBS-28, KBS-33, KBS-38, KBS-5, KBS-40, KS-101 were showing the intermediate values. For days to maturity mean values ranged between 225.7 (farmer's variety) and 221.7 (KBS-49) rest of the genotypes possessed the intermediate values. Plant height across different environments shows that the tallest cultivar was KBS-49 (126.2 cm) whereas shortest genotype was the farmer's variety (110.8 cm). Mean value for primary branches per plant ranged from 5.42 (SBS-1) to 6.89(KBS-49. Estimates of mean values for length of main raceme varied from 46.02 (Farmer's variety) to 56.06 (KBS-49). The mean number of siliquae ranged from 48.39 (Farmer's variety) to 57.67 (KBS-49). The mean values of number of siliquae per plant ranged from 48.39 (Farmer's variety) to 57.67 (KBS-49). The mean value for the number of seeds siliqua^{-1} ranged from 14.78 (Farmer's variety) to 20.02 (KBS-49). The genotype KBS-49 had the maximum seed yield plant (6.68 g) while the minimum seed yield plant was shown by the genotype SS-1 (3.52 g) respectively with a mean seed yield of 5.34 g plant^{-1}. Mean values for1000-seed weight ranged from 2.70 (Farmer's variety) to 3.19 (KBS-49).

Table 2. shows the factor loadings for principal component 1 and principal component 2. The fact that Eigen values are above 1 indicates that the evaluated principle component weight values are reliable (Mohammadi and Prasanna, 2003). Latent roots (eigen values) are between 6.703 for the first principal component and 1.06 for the second principal component. Plant height and 1000-seed weight were the important traits in first principal component , so is designated as factor of productivity whereas in principal component 2 most of the traits were found to be negative. The maximum contribution to principal component 1 was shown by plant height (13.413) followed by 1000- seed weight (12.010) and number of siliqua per plant (11.976) whereas primary branches per plant shows maximum value (36.953) in principal component 2 followed by number of siliqua on main raceme (27.655) and seed yield per plant (26.056) (Table 3). The contribution of different genotypes to principal components indicates that KBS-49 (4.216) shows maximum value for principal component 1 followed by KBS-33 (2.158). KBS-40, KBS-28, KS-101, SS-1, Farmer's variety were having negative values for principal component 1.KBS-5 (1.083) contributes maximum value to principal component 2 (Table 4).

IV.TABLES

Table 1 : Mean performance for ten *Brassica rapa* genotypes for 10 quantitative traits

Genotypes	DF	DM	PH	PBPP	LMR	NSMR	NSPP	NSPS	100SW	SYPP
KBS-69	170.1	222.8	122.2	6.1	0.01	57.65	220.7	18.66	3.13	6.34
KBS-33	168.4	222.6	122.8	6.64	0.006	55.73	220.1	19.18	3.12	6.15
KBS-49	167.6	221.7	126.2	6.89	0.016	57.67	229.6	20.02	3.19	6.68
KBS-38	170.2	222.8	124.2	6.61	0.01	56.76	225.9	16.11	3.17	6.53
KBS-5	168.8	224.8	119.8	6.32	0.012	49.79	214.8	18.85	3.11	5.64
KBS-40	171	223.9	114.3	6.11	0.019	49.06	210.4	16.27	2.89	5.41
FV	171.6	225.1	110.8	5.88	0.02	48.39	209.2	14.78	2.7	4.32
KBS-28	171.1	225.7	118	6.4	0.02	53.2	215.1	17.74	3.08	5.12
KS-101	170.1	223.4	113.5	5.51	0.017	54.36	209.6	17.06	3.01	3.67
SS-1	170.6	224.3	120.5	5.42	0.018	55.39	219.1	17.53	2.99	3.52

Table 2: Factor loadings for PC-1 and PC-2

Trait	PC- 1	PC- 2
DF	-0.321	-0.030
DM	-0.299	0.203
PH	0.366	-0.090
PBPP	0.283	0.608
LMR	-0.281	-0.077
NSMR	0.298	-0.526
NSPP	0.346	-0.105
NSPS	0.300	-0.115
100SW	0.347	-0.113
SYPP	0.309	0.510
Eigen value	6.703	1.06
% variability	67.03	10.6
Cumulative % age	67.03	77.63

Table 3: Contribution of traits to principal components

Trait	PC-1	PC-2
DF	10.314	0.093
DM	8.956	4.129
PH	13.413	0.809
PBPP	7.998	36.953
LMR	7.870	0.594
NSMR	8.908	27.658
NSPP	11.976	1.111
NSPS	9.026	1.311
1000-SW	12.010	1.286
SYPP	9.529	26.056

Table 4: Genotype wise component scores of ten *Brassica rapa* genotypes.

Traits	PC-1	PC-2
KBS-69	1.868	-0.592
KBS-33	2.807	0.379
KBS-49	4.216	0.021
KBS-38	2.158	0.348
KBS-5	0.329	1.083
KBS-40	-2.403	1.034
(Farmer's variety)	-4.515	0.848
KBS-28	-1.187	0.515
KS-101	-1.966	-1.553

SS-1	-1.303	-2.084

V.CONCLUSION

The principal component analysis was effective for classification of the quantitative traits that explained most of the variability of the studied genotypes. In this data set, the characters were appointed to five PCs, out of which the first three PCs explained 63% of the total variance. It served as a useful tool for detection of traits for which the genotypes expressed the highest differences and facilitated the choice of variables based on which the clustering of the germplasm could be performed.

REFERENCES

[1.] Khaleque, M.A. 1985. A guide book on production of oil crops in Bangladesh. DAE and

[2.] FAO/UNDP project BGA/79/034, strengthening the Agricultural Extension Service

[3.] Khamarbari, Farmgate, Dhaka. P. 3.

[4.] Gupta, S.K. And Pratap, A. 2007. History origin and evolution of oilseed *brassica*. A*dvances in botanical research* **45** : 1-20.

[5.] Anonymous, 2013.Area,and productivity of oilseed in J&K state. Digest of Statistics, \

[6.] Directorate of Economics and Statistics Planning and Development Department,

[7.] Government of J&K, Srinagar, pp. 94-100.

[8.] Kovacic, Z. (1994): Multivarijaciona analiza. Univerzitet u Beogradu, Ekonomski fakultet, 282str

[9.] Acquaah, G, Adams, MW and Kelly, JD (1992): A factor analysis of plant variables

[10.] associated with architecture and seed size in dry bean, *Euphytica*, **60**:171-177.

[11.] Johnson., R.A. and Wichern., D.W. (1996). Applied multivariate statistical analysis. Sterling Book House New Delhi.

[12.] Khameneh, MM, Bahraminejad, S, Sadeghi, F, Honarmand, J and Maniee, M (2012). Path

a. analysis and multivariate factorial analyses for determining interrelationships

b. between grain yield and related characters in maize hybrids. *African Journal of*

[13.] *Agricultural Research* **7**: 6437-6446

[14.] Ananda, I.J., and D.S. Rawat. (1984).Genetic diversity, combining ability and heterosis in

a. brown mustard. *Indian Journal of Genetics* **44**: 226-234.

[15.] Choudhary B. R., P. Joshi (2001): Genetic diversity in advanced derivatives of *Brassica*

a. interspecific hybrids. *Euphytica* **121***:* 1-7.

[16.] Joseph, T.A., R.K. Birhman, S.K. Sood, and J. Gopal. 1999. Genetic divergence in new

a. potato genotypes. *J. Indian Potato Assoc.* **26**(3 & 4): 119-125.