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Study of genetic diversity in rapeseed and mustard germplasm by using cluster analysis

Abstract

The present study focuses on examining the genetic diversity in 104 accessions of rapeseed and mustard germplasm gathered from different regions of Pakistan. Correlation studies revealed positive correlation of yield component with morphological characters at 5% and 1% level of significance Cluster analysis divided the accessions into five major clusters I, II, III, IV and V. These diverse the germplasm are appropriate for planning of hybridization of programs.

Keywords: cluster, germplasm, accessions, diversity

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Muhammad Ahson Khan,[1] Irum Raza,[1] M Asif Masood,[1] Saleem Abid,[2] Saima Rani,[2] Naheed Zahra,[2] Haider Abbas[2]

[1]Bio resources Conservation Institute, National Agriculture Research Centre, Pakistan
[2]Social Sciences Research Institute, National Agriculture Research Centre, Pakistan
[3]Crop Sciences Institute, National Agriculture Research Centre, Pakistan

Correspondence: Irum Raza, Social Science Research Institute, NARC, Islamabad, Pakistan, Email irumraza83@gmail.com

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Introduction

Rapeseed (*Brassica rapa* and *Brassica napus*) and mustard (*Brassica juncea*), including the canola varieties, are among the most important oilseed crops in Pakistan. During 2010-2011, rapeseed and mustard were grown over an area of 203100 hectares in Pakistan out of which 17200 hectares were under canola varieties. Production of rapeseed and mustard was 176400 tons with 18600 tons of canola.[1] During the year 2011-12, the total availability of edible oil in Pakistan was 2.748 million tonnes. Local production of edible oil was 0.636 million tonnes while 2.148 million tonnes were imported.[2] In order to increase the production of edible oil in Pakistan, efforts are required to increase the production of oilseed crops including rapeseed and mustard. Introduction of canola varieties resulted in significant improvement of quality and production of rapeseed and mustard. However, in addition to the oil quality and seed characters, the genetic improvement for other economically important characters is also important. Study of genetic diversity in rapeseed and mustard germplasm is important for the selection of suitable genotypes for breeding programs.[3–6] The present study was conducted to study the genetic diversity in germplasm resources of rapeseed and mustard from Pakistan for agro-morphological characters and selection of suitable material to be utilized in crop improvement.

Material and methods

A total of 104 accessions of rapeseed and mustard germplasm, including the landraces and cultivars, collected from different regions of Pakistan were used in the study. The experiment as conducted at Plant Genetic Resources Institute, National Agricultural Research Center, Islamabad. Germplasm accessions along with check variety Khanpur Raya were sown in the field during winter 2012-2013 using augmented design. Data were recorded for agro-morphological characters including days to 50 percent flowering, days to 100 percent flowering and days to maturity; qualitative morphological characters including leaf margin, leaf color, branching, mature leaf dissection, flower color, corolla shape, pedicel length and angle, leaf shape and stem shape; quantitative morphological characters including plant height, number of branches per plant, silique per raceme, raceme length, stem diameter, leaves per plant, pedicel length, leaf length, leaf width, silique width, silique length, seeds per silique and 100 grain weight. Ten plants of each accession were selected for data recording of qualitative and quantitative morphological characters and average was calculated for data analysis. Data for flowering and maturity was recorded from overall population of each accession.

Qualitative morphological characters were assessed through frequency distribution while in case of quantitative agro-morphological characters, frequency distribution, descriptive statistics correlation analysis and cluster analysis of germplasm were performed for all the characters using the software MINITAB 16.

Results and discussion

Frequency distribution for nine qualitative morphological characters in germplasm accessions (Table 1) showed a variation for all the characters except leaf color.

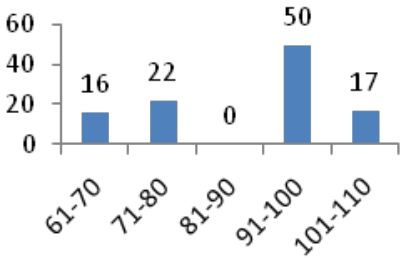
Frequency distribution for three physiological and twelve quantitative agro-morphological characters shows variation for all the characters studied (Figure 1). Descriptive statistics indicate that the variation is significant for all the characters (Table 2). Selection of suitable accessions for each character was made as shown in Table 3. The superior lines can be studied in detail for the development of short duration high yielding cultivars.

Correlation studies indicate the association of yield components with physiological and morphological characters (Table 4). Characters having positive correlation with yield components may help for the selection of promising lines (Figure 2).

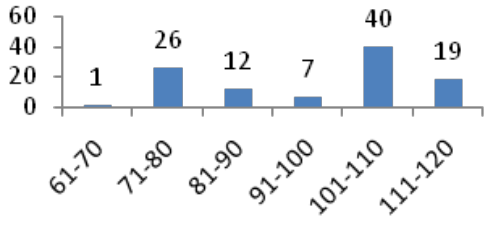
Cluster analysis of germplasm on the basis of all the characters studied divided the germplasm into five major clusters at linkage distance of 20. The diverse germplasm accessions are suitable for the planning of hybridization programs. The dendrogram classified 104 accessions into 5 clusters based on the similarity of morphological characters within the clusters. A number of authors have made use of the cluster analysis technique for the determination of genetic similarity. The construction of dendrograms makes it possible to further visualize and interpret the findings of other studies.[7–10]

Table 1 Frequency distribution for qualitative morphological characters in 104 germplasm accessions and check variety of rapeseed and mustard

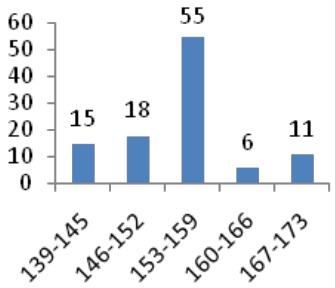
Characters	Categories	Accessions
Branching	Basal	11
	Normal	94
Stem shape	Irregular	35
	Round	70
Leaf color	Green	105
Leaf margins	No serration	1
	Crenate	22
	Dentate	48
	Doubly dentate	34
Leaf shape	Elliptic	74
	Orbicular	1
	Ovate	28
	Pandurate	2
Mature leaf dissection	Lyrate	95
	Parted	10
Pedicel length and angle	Typical pedicel length and angle	94
	Short and very close to stem	11
Flower color	Light yellow	10
	Yellow	94
	White	1
Corolla shape	Thin elliptical	34
	Elliptical	66
	Round	5



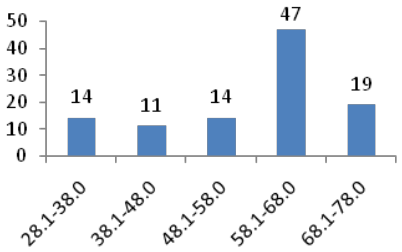
Days to 50 percent flowering



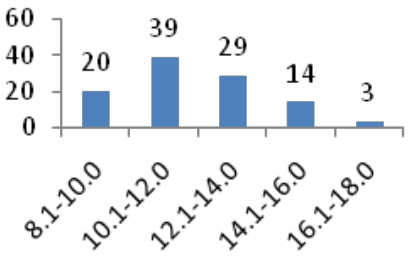
Days to 100 percent flowering



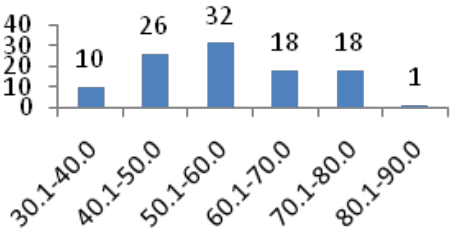
Days to maturity



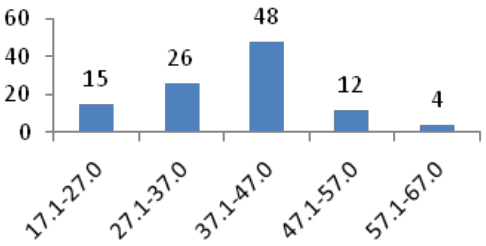
Plant height (cm)



Number of branches per plant



Number of silique per raceme



Raceme length (cm)

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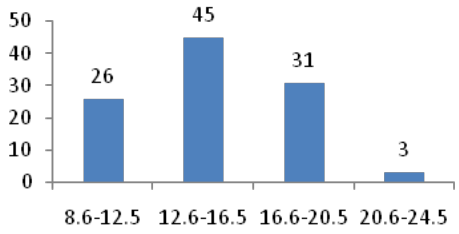
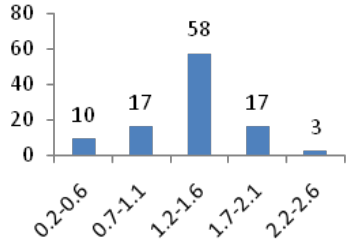
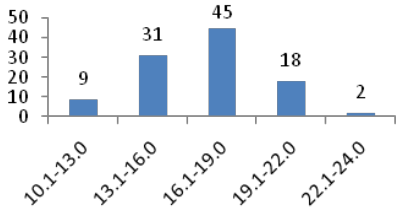


Stem diameter (mm)

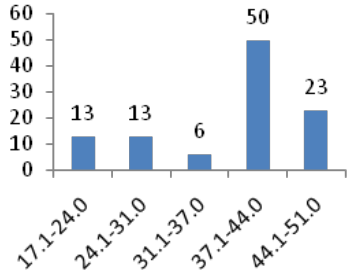
Figure 1(a) Frequency distrubution for quantitative agro-morphological characters in 104 germplasm accessions and check variety of rapeseed and mustard.



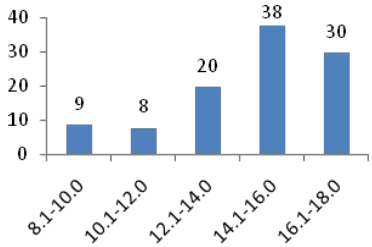
Pedicel length (cm)



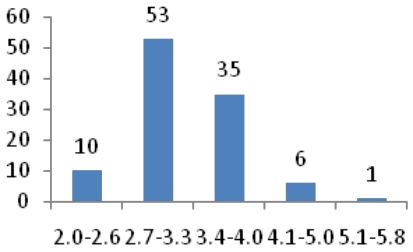
Number of leaves per plant



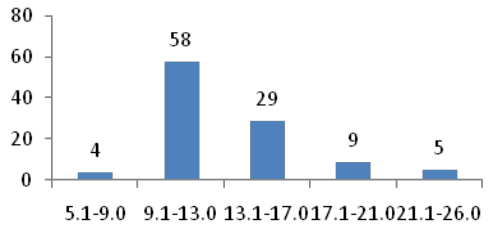
Leaf length (cm)



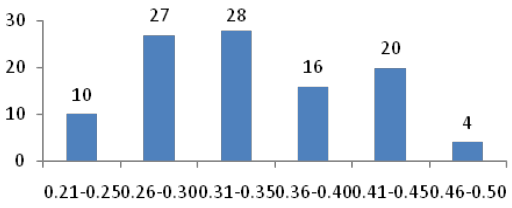
Leaf width (cm)



Silique width (cm)



Seeds per silique



100 Grain weight

Figure 1(b) Frequency distrubution for quantitative agro-morphological characters in 104 germplasm accessions and check variety of rapeseed and mustard.

Table 2 Descriptive statistics for quantitative agro-morphological characters in 104 germplasm accessions and check variety of rapeseed and mustard

	Mean	Standard Error	Sample Variance	Minimum	Maximum
Days to 50 percent flowering	89.848	1.407	207.765	62	108
Days to 100 percent flowering	95.457	1.499	235.789	66	114
Days to maturity	153.695	0.836	73.31	139	174
Plant Height	57.392	1.193	149.329	29.8	78
Number of branches per plant	12.018	0.188	3.726	8.6	17.6
Number of silique per raceme	55.73	1.2	151.298	30.5	81
Raceme length	38.166	0.92	88.813	17	66.4
Stem diameter	14.883	0.3	9.447	8.618	22.47

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Table Continues...

	Mean	Standard Error	Sample Variance	Minimum	Maximum
Number of leaves per plant	16.812	0.257	6.94	10.2	23
Pedical length	1.332	0.041	0.18	0.32	2.44
Leaf length	37.162	0.852	76.133	17.4	48.6
Leaf width	14.432	0.238	5.955	8.1	17.86
Silique width	3.287	0.054	0.307	1.958	5.7532
Silique length	4.155	0.077	0.626	2.0336	5.984
Seeds per silique	13.472	0.35	12.865	7.36	25.68
100 Grain weight	0.338	0.007	0.005	0.2262	0.4736

Table 3 Selection of superior lines for agro-morphological characters in 104 germplasm accessions of rapeseed and mustard

Characters	Accessions
Day to 50 percent flowering	1389, 928, 1319, 1450, 1472
Day to 100 percent flowering	1389, 928, 1319, 1450, 1472
Days to maturity	1480, 1481, 1482, 1489, 1497
Plant Height	24931, 1493, 24921, 24928, 24924
Number of branches per plant	1321, 24943, 1387
Number of silique per raceme	24724, 24720, 24725, 24712, 24713
Raceme length	26827, 24944, 1494, 1495
Stem diameter	1648, 26827, 24943
Number of leaves per plant	1387, 24708, 24719
Pedicel Length	1495, 1493, 1472
Leaf length	24705, 24706, 24711, 24921, 24707
Leaf width	1474, 24921, 1477, 24956, 24718
Silique width	1480 1478 1459 1464 1489 1473 1468
Seeds per silique	1449, 931, 1496, 1454, 1455
100 Grain weight	24921, 1498, 24712, 24726

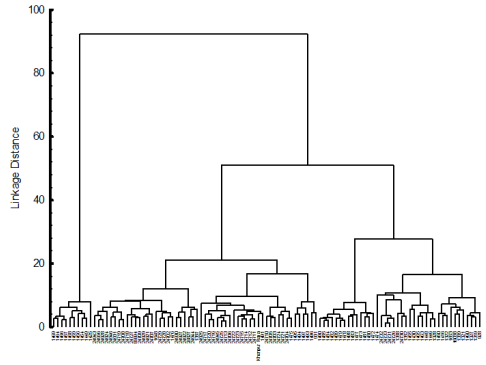

Figure 2 Cluster analysis using wards method in 104 germplasm accessions and check variety of rapeseed and mustard.

Acknowledgments

None.

Conflicts of interest

The author declares there are no conflicts of interest.

Funding details

None.

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