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BOTANICAL DESCRIPTION OF SIX BRASSICA SPECIES WITH RELEVANCE TO THEIR QUANTITATIVE AND MORPHOLOGICAL CHARACTERISTICS

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ABSTRACT

Brassica (a cross of *Brassica oleracea* and *Brassica rapa*) belongs to Brassicacea family ranked the third most important source of edible oil and covers more than 15% of the world's edible vegetable oil. In this study, the performance of various Brassica varieties was evaluated concerning quantitative and morphological characters and to identify the botanical descriptions of Brassica species. Six Brassica accessions were evaluated for their morphological characters and their related traits. The experiment was conducted following a Randomized Complete Block Design (RCBD) with three replications. The data was recorded on quantitative traits i.e. germination, plant height, number of leaves, leaf length, leaf width, number of Silique, number of primary branches, number of secondary branches, number of seeds per plant, and 1000 seed weight. Recorded data were subjected to analysis of variance, and correlation to evaluate the performance of various Brassica varieties concerning quantitative characters and to identify the botanical and morphological descriptions of Brassica species among various traits in Brassica. The accession, Uaf16, was a comparatively better-performing accession among all selected accessions. Plant height, leaf length, and no. of seeds had a significant and positive correlation with leaf width and seed weight. Whereas, seed weight has a negative significant correlation with plant yield, primary and secondary branches showed a negative significant correlation with R1. R1 which is the leaf length/width ratio has a significant positive correlation with plant yield, and seed weight and a significant negative correlation with leaf width. All the traits showed a positive direct effect on seed yield except plant height.

Key Words: Brassica, Accessions, Comparative Performance, Quantitative Traits, Morphological Characters, Botanical Description,

INTRODUCTION

Edible oil is one of the major products of daily consumption. After cereal and sugar crops in Pakistan oilseeds are important for the human diet. Rapeseed is an important oil crop all over the world. Oil from rapeseed varieties is superior for human consumption and meal is a tremendous feed for animals, birds and specifically for poultry, it is a second chief source of protein meals. Pakistan has been constantly and frequently lacking in oilseed production. The development of improved rapeseed lines enhances the quality of rapeseed oil for the edible purposes for human food and animal feed [1]. Brassica has great importance as an oilseed crop and has a major share in Pakistan's economy. Its

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cultivated area is 265.8 thousand hectares and its production is 221 thousand tons which were only 14% of the total requirement. Rapeseed oil production is 71 thousand tons and the share in local oil production is 2%. In Pakistan rapeseed cultivated area is 575 thousand hectares and production is 218 thousand tons [2. *B. carinata, B. campestris, B. oleracea, B. napus, B.juncea,* and *B. nigra are species of genus Brassica. B. carinata, B. campestris, B. juncea B. napus* play an important role in the production of edible oil. *Brassica napus* are now the 2nd largest oilseed crop in the world after soybean and produces 13% of the total edible oil. Brassica has about 40% more oil and provides meals with 35 to 40% protein used primarily for animal feed [3], [4].

Rapeseed is an annual herb. Its height ranges from 30cm to 1m. It has a tap root system. The stem has many branches, herbaceous in nature, erect, and greenish-red to reddish-purple in color. It has alternate, simple and hairy leaves which are oblong, thicker, and sessile. Inflorescence is a terminal raceme. It contains 20-30 seeds and the seeds are red-brown to a black in color and curved [5]. On a dry seed weight basis, its seeds contain 25% protein and 50% oil contents [6]. The total requirement of edible oil is 3.623 million tons which includes 0.431million tons of local production and import of 3.191 million tons of edible oil to fulfill the oil requirements, cotton contributes 77%, canola 1%, sunflower 8%, and rapeseed is contributing 14 %. Pakistan has the agro-based economy and the majority of its people are entirely dependent upon this sector. Pakistan has made tremendous progress in the agricultural sector and it performed well with an increased growth of 3.83 percent against the last year's growth of 0.91 percent [7]. With the Advancement in agriculture production technologies, good work has been done on *Brassica napus L.* which belongs to the brassicaceae family. The chromosome number of napus is n=19. Brasscicaceae family consists of 375 genera and 3200 species of plants of which about 52 genera and 160 species are present in Australia [8]. Brassica napus originated from a cross of "*Brassica oleracea* and *Brassica rapa*" which are closely related to two diploid species [9]. Brassica oilseed recently has received considerable attention in Canada and Europe, which resulted in an increase of 53% in oil production in these countries [10]. Correlation among traits helps to determine the effect of different traits on seed yield because seed yield is a complex character that can be controlled by several components having positive or negative effects on traits. Seed yield is the most important selection criterion for rape breeding. The correlation coefficient expresses the relationship among independent characters and the degree of linear relation among these characters. The use of simple correlation analysis is not explaining the relationship among traits. Path analysis is essential to clarify relationships among characters deeply due to correlation coefficients define relationships in a simple manner [11]. Correlation gives an idea about the co-inheritance of two traits that helps in defining yield contributing characters. The situation of edible oil in Pakistan needs to improve through different strategies. Efforts are being made to increase the oilseed's local production instead of import. The major oilseed crop *Brassica* has the potential to improve oil production in Pakistan. But there are several factors responsible for the low yield of *Brassica*. The most important factor is the non-availability of the high-yielding cultivars. The production of improved varieties with high

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yield is a primary goal of the breeding program. Increasing yield is dependent on the amount of genetic variability of different quantitative traits [12]. High heritability would be an effective tool for crop improvement. It is helpful in selection criteria and also valuation of genetic improvement in the succeeding population. The assessments of only heritability do not suggest genetic progress that would consequence from selecting the best plants. Heritability with phenotypic variance and the selection strength, promise the valuation of genetic advance which is helpful in selection [13].

MATERIAL AND METHODS

Experimental conditions

An experiment was carried out to evaluate the 6 Brassica accessions. The study was conducted in the research area of Plant Breeding and Genetics at the University of Agriculture Faisalabad, Pakistan in a growing period 2017-18. Faisalabad is located in the flat plains of northeast Punjab with geographical synchronizes of 31° to 26°N latitude and 73° to 06° E longitude. Faisalabad is an arid climate region due to high evapotranspiration and its elevation above the sea level is 184.4 meters. The average rainfall recorded is nearly 300mm. Faisalabad soil is very fertile and consists of alluvial deposits mixed with loess having calcareous physical characteristics. The average maximum and minimum monthly temperature and total rainfall during the growing period of *Brassica napus* are presented in Fig 3.1 (a) and Fig 3.1 (b) respectively.

Experimental Material

The experimental material consisted of six accessions of *Brassica campestris* viz, Uaf11, Uaf12, Uaf16, Chkwal sarson, Punjab sarson, Dunklet sarson, developed and collected from Oilseed Research Group, Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad.

Experimental Layout

The seeds of six genotypes of Brassica were grown in the experimental field. The experiment was laid out in a Randomized Complete Block Design with three replications. Plant to plant distance was 30 cm and row to row distance was 60 cm. The seeds of Brassica were sown in the field with the help of a drill. There were three rows of each genotype per replication and the length of each row was 10 meters. The total application of water was two throughout the crop growing season. First irrigation was applied at 32 days after sowing and second irrigation was applied at 50 days after first irrigation. At the time of sowing one bag of DAP fertilizer was applied per acre while the half urea was applied at the first irrigation and half at the second irrigation. All recommended agronomic practices were applied from sowing to till harvesting.

Data Recording

Randomly selected ten plants of each genotype per replication and data were recorded for various quantitative traits.

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Quantitative Traits

1. Plant height

Plant height of randomly ten tagged plants of each accession per replication was calculated in cm from the bottom to top of the plant with the help of a measuring instrument.

2. Number of primary branches

These were counted from ten tagged plants of each accession per replication.

3. Number of secondary branches

These were counted from ten selected plants of each accession per replication.

4. Number of leaves per plant

The total numbers of leaves on primary and secondary branches were counted from ten tagged plants of each accession per replication.

5. Number of silique per plant

The total numbers of silique on primary and secondary branches per plant were counted for ten selected plants per accession per replication.

6. 1000 seed weight (g)

One thousand seeds were counted and weighed with the help of an electronic balance instrument of each genotype per replication.

7. Seed yield per plant

The total number of silique of each tagged plant per accession per replication was threshed carefully and weighed the obtained seed with the help of electronic balance.

Statistical Analysis

Analysis of variance: Recorded data of field experiments were subjected to the analysis of variance [14].

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Table 1: Parameters of statistical Analysis

Source of Variation	Degree of freedom	Sum of Squares	Mean Square	Expected Mean Square	F_{cal}
Replications	(r-1)	1206.06	603.03	603.03	2.75
Accessions	(a-1)	SS_1	MS_1	$S^2_e + rS^2_g$	$S^2_e+rS^2_g/S^2_e$
Error	(r-1)(a-1)	SS_2	MS_2	S^2_e	
Total	(ra-1)				

Where,

r = Replication

a = Accessions

S^2_g = Genotypic variance

S^2_e = Environmental variance

The significant data were further subjected to the least significant difference test (Tukey's) for individual comparisons of genotypic means and the total variation was split into its phenotypic and genotypic components.

Genotypic variance (V_G) = $(MS_2-MS_1) / r$

Phenotypic variance (V_P) = $V_E + V_G$

Environmental variance (V_E) = MS_2

RESULTS AND DISCUSSIONS

Analysis of variance for Plant height (cm)

Analysis of variance and mean comparison for plant height of Brassica accessions are presented in Tables 3 and 4, respectively. Significant differences among accessions for plant height were found. This shows that our material has genetic variability for plant height. Plant height ranged from 74.99 to 156.57 cm in the research material studied. Maximum plant height was taken by accession-4 which was significantly different from all other accessions except 5, 6, and 2. So, our accessions had a considerable variation for plant height. The varieties were subjected to Tukey HSD all pair-wise comparison tests.

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The mean comparison of different accessions was also represented in the mean comparison table.

Table: 2 Analysis of Variance of All Six Accessions with Their Replications

SOV	DF	SS	MS	Fcal	DF	SS	MS	Fcal	DF	SS	MS	Fcal
	Plant Height (cm)				Leaf Length (cm)				Leaf Width (cm)			
Replication	2	1206.06	603.03	2.75	2	84.96	42.48	2.01	2	26.72	13.36	2.48
Accessions	5	184850	36970	168.37**	5	9141.58	1828.32	86.64**	5	2843.21	568.64	105.39**
Error	172	37766.3	219.57		172	3629.82	21.1		172	928.021	5.39	
	No. of Seeds				Weight 1000 Seeds (g)				Mean yield (g)			
Replication	2	2	2.91	2.91	2.91	2.91	1.45	0.24	2	0.41	0.2	0.55*
Accessions	5	5	673.64	673.64	673.64	673.64	134.72	22.19**	5	4.04	0.8	2.15
Error	172	172	1044.17	1044.17	1044.17	1044.17	6.07		172	64.85	0.37	
	Primary Branches				Primary Branches				R1 Leaf length/width ratio			
Replication	2	0.41	0.2	0.55*	2	1.87	0.93	1.37*	2	0.49	0.24	0.29
Accessions	5	4.04	0.8	2.15	5	15.84	3.16	4.62*	5	67.1	13.42	15.71**
Error	172	64.85	0.37		172	117.92	0.68		172	146.95	0.85	

SOV= Source of variance, DF= Degrees of freedom, SS= Sum of squares, MS= Mean square, **= highly significant

Table: 3 Comparisons of Six Accessions (Mean and Significance) of Different Characteristics

Sr. No.	Acc.	Mean	Signif.	Acc.	Mean	Signif.	Acc.	Mean	Signif.	Acc.	Mean	Signif.	Acc.	Mean	Signif.
	Plant Height (cm)			Leaf Length (cm)			Leaf Width (cm)			No. of Seeds			Weight 1000 Seeds (g)		
1	4	156.57	A	4	27.14	A	4	12.2	A	2	2653.2	A	6	5.53	A
2	5	152.6	A	5	19.98	B	5	11	A	3	2457.4	A	4	4.9	A
3	6	137.97	B	6	16.81	C	6	4.92	A	1	2381.2	A	1	4.61	A
4	2	103.84	C	2	10.87	D	2	3.03	B	5	1843.2	B	2	4.51	B
5	1	85.9	D	1	7.66	E	3	2.92	C	6	1811	B	5	3.52	B
6	3	74.99	E	3	7.37	E	1	2.58	C	4	1439	C	3	3.27	C
	Mean yield per Plant(g)			Primary Branches			Secondary Branches			R1 Leaf length/width ratio					
1	2	11.80	A	6	1.93	A	3	3.53	A	2	3.67	A			
2	1	10.85	B	2	1.80	A	4	3.00	A	6	3.60	B			
3	6	9.22	C	3	1.66	B	5	2.96	B	1	3.01	C			
4	3	7.87	D	5	1.63	B	2	2.93	B	3	2.73	C			
5	4	7.22	D	4	1.53	B	1	2.70	B	4	2.42	D			
6	5	6.40	D	1	1.50	B	6	2.60	B	5	1.96	D			

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The highest mean value was was 156.57 indicated by accession number 4 and the lowest value was 74.99 was indicated by accession number 3. Mean sharing same letters are non-significantly different from each other. So, the research lines can be successfully used for future breeding progress in Brassica. The findings are in accordance with Singh *et al*., [15], Li and Guan [16], and Sinha et.al., [17] who reported high variability for plant height during their experiments. These results are, however, not in accordance with the findings of Woyke et. al., [18], Shpota et. al., [19], and Yadav and Singh [20].

Analysis of variance for leaf length (cm)

Analysis of variance and mean comparison for leaf length of Brassica accessions are presented in Tables 3 and 4, respectively. Significant differences among accessions for leaf length were found. This shows that our material has genetic variability for leaf length. Leaf length ranged from 7.37 to 27.14cm in the research material studied. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in a mean comparison table. The highest mean value was 27.14 indicated by accession number 4 and the lowest value 7.37 was indicated by accession number 3. Mean sharing same letters are non-significantly different from each other. So, our accessions had a considerable variation for leaf length. The research lines can be successfully used for future breeding progress in Brassica. The results coincide with the findings of Chowdhury and Chowdhury [21] and Thurling [22] who reported high variability for leaf length in Brassica *campestris* L. and Brassica napus L. while the results are not in accordance with Shpota [19] who reported the least variability for this character in *Brassica campestris L.*

Analysis of variance for Leaf width:

Analysis of variance and mean comparison for leaf width of Brassica accessions are presented in Tables 3 and 4, respectively. Significant differences among accessions for leaf width were found. This shows that our material has genetic variability for leaf width. Leaf width ranged from 2.58 to 12.21 cm in the research material studied. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in the mean comparison table. The highest mean value was 12.21 indicated by accession number 4 and the lowest value was 2.58 indicated by accession number 3. Mean sharing same letters are non-significantly different from each other. So, our accessions had a considerable variation for leaf width. The research lines can be successfully used for future breeding progress in Brassica.

Analysis of variance for the number of seeds:

Analysis of variance and mean comparison for the number of seeds of Brassica accessions are presented in tables 3 and 4, respectively. Significant differences among accessions for several seeds were found. This shows that our material has genetic variability for several seeds. The accession-2 was statistically significantly different from all other accessions in the present study. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also

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represented in the mean comparison table. The highest mean value was 2653.2 indicated by accession number 2 and the lowest value 1439.0 was indicated by accession number 4. Mean sharing same letters are non-significantly different from each other. So, our accessions had a considerable variation in the number of seeds per plant. So, the research lines can be successfully used for future breeding progress in Brassica. The results are similar to the findings of Chowdhury and Chowdhury [21] and Labana [23] who observed high variability for this character in *Brassica campestris* L. and Brassica Juncea L. However, Li and Guan [16] and Yadav and Singh [20] reported less variation for this character in Brassica napus L.

Analysis of variance for the weight of 1000 seeds (g)

Analysis of variance and mean comparison for 1000 seed weight of Brassica accessions are presented in table 3 and 4, respectively. Significant differences among accessions for 1000 seed weight were found. This shows that our material has genetic variability for 1000 seed weight. The means ranged from 3.27 to 5.53 in research material. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in the mean comparison table. The highest mean value was 5.53 indicated by accession number 6 and the lowest value was 3.27 was indicated by accession numbers 2, 5, and 3. Mean sharing same letters are non-significantly different from each other. So, the research lines can be successfully used for future breeding progress in Brassica. The results coincide with the findings of Chowdhury and Chowdhury [21] and Chaubey and Katiyar [24] who reported high variability for this trait. The results differed from Li and Guan [16] and Yadav and Singh [20] who reported that this character was less variable.

Analysis of variance for Seed yield per plant (g):

Analysis of variance and mean comparison for seed yield of Brassica accessions are presented in Tables 3 and 4, respectively. Significant differences among accessions for seed yield per plant were found. This shows that our material has genetic variability for seed yield per plant. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in the mean comparison table. The highest mean value was 11.80 indicated by accession number 2 and the lowest value was 6.40 was indicated by accession number 5. Mean sharing same letters are non-significantly different from each other. So, our accessions had a considerable variation for seed yield per plant. The research lines can be successfully used for future breeding progress in Brassica. The results are in accordance with the findings of Yadava [25] who reported high variability for this character.

Analysis of variance for Primary branches:

Analysis of variance and mean comparison for primary branches of Brassica accessions are presented in Tables 3 and 4, respectively. Significant differences among accessions for primary branches were found. This shows that our material has genetic variability for primary branches. Table 4.7b indicated that the mean ranges between 1.93 to 1.50 with

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a maximum of 1.93 in accession-6 and a minimum of 1.50 in accession-1. The character number of primary branches is a highly variable character in this study. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in the mean comparison table. The highest mean value was 1.93 indicated by accession number 6 and the lowest value was 1.50 was indicated by accession number 1. Mean sharing same letters are non significantly different from each other. The research lines can be successfully used for future breeding progress in Brassica. The results are in accordance with Li and Guan [16] who reported high variability for the number of primary branches per plant in their experiments on *Brassica napus L*. So, our accessions had a considerable variation for primary branches.

Analysis of variance for Secondary branches

Analysis of variance and mean comparison for Secondary branches of Brassica accessions are presented in tables 3 and 4, respectively. Significant differences among accessions for secondary branches were found. This shows that our material has genetic variability for secondary branches. Table 4.8b indicated that the mean ranges between 3.53 to 2.60 with a maximum of 3.53 in accession-3 and a minimum of 2.60 in accession-6. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in the mean comparison table. The highest mean value was 3.53 indicated by accession number 3 and the lowest value of 2.60 was indicated by accession number 6. Mean sharing same letters are non-significantly different from each other. The research lines can be successfully used for future breeding progress in Brassica. The result coincides with the findings of Yadava [25] and Sinha [17] who reported high variability in character number of secondary branches per plant during their research work.

Analysis of variance for Leaf length/width ratio (R1):

Analysis of variance and mean comparison for RI of Brassica accessions are presented in table 3 and 4, respectively. Significant differences among accessions for RI were found. This shows that this material has genetic variability for RI. RI ranged from1.96 to 3.67 cm in the research material studied. The varieties were subjected to Tukey HSD all pair-wise comparison tests. The mean comparison of different accessions was also represented in the mean comparison table. The highest mean value was 3.67 indicated by accession number 2 and the lowest value was 1.96 was indicated by accession number 5. Mean sharing same letters are non-significantly different from each other. So, our accessions had a considerable variation for R1. The research lines can be successfully used for future breeding progress in Brassica.

Brassica is an important source of edible oil all over the world and covers a considerable share of the world's edible vegetable oil. The information about the quantitative and morphological character is necessary not for farmers but also for the scientific community. There are many procedures to describe the botanical characteristics of species. The morphological characters are well analyzed by using morphological parameters/traits. The field trials are the most essential way the screening existing accessions in terms of

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morphological variation, especially the quantitative traits. The Different cultivars express their genetic potential independently in different/specific environmental conditions. The expressions of morphological characters are based on their genetic diversity [26]. The morphological characters are expressive in specific environmental conditions and play an important role in the quantitative description of botanical characters of any species. This study was conducted to assess the quantitative traits of *Brassica rapa* germplasm collected from the different areas of Punjab (Pakistan) with relevance to their morphological characters. The present work is carried out to evaluate these six accessions (Uaf11, Uaf12, Uaf16, Punjab, Chkwal, and Dunklet) of Brassica to facilitate the farming and scientific community in our agro-ecosystem. Field experiments were carried out by selecting morphological characters (days to germination, number of primary branches/plant, secondary branches/plant, number of silique/plant, plant height, seeds/pod, length of silique, yield/plant, and weight of 1000 seeds) to evaluate these accessions of Brassica. The major differences were noted in terms of morphological characters among these accessions as determined by many others [27], [28], [29], [30]. First of all, I have selected 6 genotypes of Brassica, Uaf11, Uaf12, Uaf16, Punjab, Chkwal, and Dunklet. Then, the quality of these seeds was checked by petri-plates with 20 seeds per replication using three replicates. We observed Uaf16 germinated within 2 days, it gives the best as compared to other varieties [31]. The germination rate was determined 100 % in Uaf16 without any damage done. These results are significantly comparable as already determined by different scientists [28], [32], [33]. So, we concluded that Uaf16 can give the best crop stand as compared to other varieties. Then, we conducted my research in the field of a botanical description of Brassica Species. I observed the quantitative characteristics of a plant at the initial stages of the plant. I observed leaf color, leaf shape, hypocotyl color, Seedling pubescence, and Juvenile development. The Brassica was quantitatively evaluated previously with heterogeneous results but the majority of the results are in-line with our findings [34], [30], [36]. The leaf color and hypocotyl color of Uaf16 were best as compared to other varieties. At the mature stage of the plant, we have observed the quantitative characteristics of Brassica species like plant height, leaf length, leaf width, no. of seeds, no of siliques, no. of primary branches, and no. of secondary branches, the yield of the plant, 1000 seed weight. All these, results are in-line with already published [29], [37], [38]. I have concluded that plant height has a positive and significant correlation with leaf length, and leaf width and a negative significant correlation with no. of seeds and yield of plant. These results are quite comparable with those already published [30], [39]. Leaf length has a positive and significant correlation with leaf width and a negative significant correlation with no. of seeds, the yield of plant, and R1. No. of seeds has a positive significant correlation with seed weight and a negative significant correlation with yield plant, R1. Seed weight has a negative significant correlation with yield plant. The results are significantly in-line with previously determined [29], [30], [32], [33]. Yield plant has a positive significant correlation with Seed weight and a negative significant correlation with R1. Primary branches had a negative significant correlation with R1. Secondary branches had a significant negative correlation with R1, seed weight. R1 which is leaf length\width ratio has a significant

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positive correlation with Yield plant, Seed weight, and a significant negative correlation with leaf width. I concluded that Uaf16 production is best as compared to other genotypes. So we should need to develop sessions with farmers to aware that Uaf16 can give the best product and it can enhance the good quality of rapeseed oil. The production of improved varieties with high yields is a primary goal of any breeding program.

Conclusion

The quantitative characters were plant height, leaf length, leaf width, number of seeds, the weight of 1000 seeds, plant yield, number of primary branches, and number of secondary branches, and R1 which is the leaf length/width ratio. Then we conducted my research in the field of a botanical description of Brassica Species. The leaf color and hypocotyl color of Uaf16 were best as compared to other varieties. At the mature stage of the plant, we have observed the quantitative characteristics of Brassica. We have concluded that plant height has a positive and significant correlation with leaf length, and leaf width and a negative significant correlation with no. of seeds and yield of plant. Leaf length has a positive and significant correlation with leaf width and a negative significant correlation with no. of seeds, the yield of plant, and R1. No. of seeds has a positive significant correlation with seed weight and a negative significant correlation with yield plant, R1. Seed weight has a negative significant correlation with yield plant. Yield plant has a positive significant correlation with seed weight and a negative significant correlation with R1. Primary branches had a negative significant correlation with R1. Secondary branches had a significant negative correlation with R1, seed weight. R1 which is leaf length\width ratio has a significant positive correlation with Yield plant, Seed weight, and a significant negative correlation with leaf width. We also applied the germination test to identify the best quality seed variety. The germination test showed that Uaf-16 was the best crop stand as compared to other verities. We concluded that Uaf16 production is best as compared to other genotypes. So we should need to develop sessions with farmers to aware that Uaf16 can give the best product and it can enhance the good quality of rapeseed oil. The production of improved varieties with high yields is a primary goal of any breeding program.

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