CHARACTERIZATION OF *BRASSICA SPP.* PROGENY LINES FOR YIELD AND ITS RELATED TRAITS

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ABSTRACT

The present research works were conducted to find out the variation in morphological traits and their relationship in *Brassica* materials at C_7 (Colchiploid) alloplasmic populations and F_5 generations with respect to their parents. Among the 19 *Brassica* progeny lines representing the cross products (*Brassica napojuncea*) of C_7 generation of *Brassica napus* and *Brassica juncea* (BINA sharisha 5 x Daulot: colchiploid-C_7) and F_5 generations with their parents, inter-species EG_2 (*Brassica napus* x *Brassica juncea*) and EG_1 (*Brassica napus* x *Brassica juncea*) showed better agronomic performance. Phenotypic characters of the genotypes were closely associated with each other for both normal correlation coefficients and Spearman's rank correlation coefficients. The total relative ranking ranged from 1 to 20 and the first rank was estimated for the genotype EG_2 genotypes. The last rank was estimated for the genotype ED_1 (*Brassica napus* x *Brassica napus*). Out of 55 associations, which found in the correlation study, 10 associations were found highly significant at the morphological level. Flower set per plant (self) showed highly significant positive association with total number of siliqua per plant (self) (r = 0.934**) but the significant negative association of the total number of siliqua per plant (self) with siliqua length was very strong (-0.489*). There was a genetic basis of association in most of the cases of pairs of relations. The Spearman's rank correlation test was studied to compare the morphological characterization for distinguishing genotypes. In this present study, this test presented 12 relationships that showed 10 positive significant and two negative significant correlations. In normal correlation coefficients 10 significant associations were found but 12 associations in Spearman's rank correlation. In these techniques, number of flower set per plant (self) had highly significant positive correlation with total number of siliqua per plant (r_s = 0.817**). The days to 50 % flowering and number of seed per siliqua (self) had significant negative correlation with number of seed per siliqua (open) (r_s = -0.546**) and number of flowers set per plant (open) (r_s = -0.563*), respectively. Finally, the study suggested that some yield related traits such as flower set per plant, number of siliqua per plant, seed per siliqua and days to 50% flowering can be selected and used in breeding program for future increasing the grain yield of rapeseed.

Key words: *Brassica;* interspecific hybridization; morphological traits; characterization

INTRODUCTION

Rapeseed and mustard are the top ranking oilseed crops in Bangladesh and it is a significant source of cooking oil that meets up one-third of the total edible oil

requirements in the country (Ahmed, 2008). In addition, it is a high-energy source along with a suitable content of fat-soluble vitamins (A, D, E and K) for our human body. In Bangladesh, the total cultivated land covered since 2011-12 was 0.483 million hectares with production and yield of 0.525 million Mt and 0.109 million Mt ha^{-1} respectively (AIS, 2013). Ultimately, it covers the highest 68% of the total oil seed acreage of Bangladesh (BBS, 2011). Moreover, this production covered only 40% of the total oil requirements of Bangladesh as per recommended dietary allowances (RDA). But unfortunately, Bangladesh has been fronting extreme deficit of edible oil during the last several decades due to fact that our domestic production cannot meet-up the total dietary requirements but only about 21% of the total consumption and rest of the portion (79%) filled-up by imports from abroad (Begum *et al*. 2012). Moreover to meet-up the high demand of the edible oil in Bangladesh, it imports 0.08997 million tons of edible oil that costs massive amount of money (371.85 million BDT) (BBS, 2011). And in Bangladesh, there is very limited scope to increase acreage due to heavy pressure of other crops, cropping patterns and human population also. Therefore, sustainable attempts should be taken to develop high yielding variety (HYV) and upsurge their adaptation in different areas of Bangladesh for cultivation. In Bangladesh, more than 18 varieties of rapeseed and mustard were developed by different organizations. And the rapeseed and mustard varieties were developed through introduction, hybridization and mutation breeding programs at both inter-varietal and inter-specific level (Naz *et al.*, 2003). But in order to improve the hybridization of varieties both at inter-variety and inter-species level it could be effective when appropriate selection techniques will be followed. In general, the main objective of my current research is to develop varieties with higher seed yield with sufficient oil content and quality. And then breeding for improvement of protein content, resistance against diseases, insects, shattering and lodging have more or less been neglected. So, the present study was conducted to characterize the morphological traits of C_7 and F_5 generation of *Brassica* inter-species and intra-species progeny lines along with their parents.

MATERIALS AND METHODS

The experiment was conducted at the field laboratory of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh, during the winter season. To study the morphological characteristic of 19 *Brassica* progeny lines representing the cross products (*Brassica napojuncea)* of the C_7 generation of *Brassica napus* and *Brassica juncea* (BINA sharisha 5 x Daulot : colchiploid- C_7) and the intra-species F_5 generation between two different varieties of *B. napus* (BINA sharisha 4 x BINA sharisha 5 and its reciprocal); and parents were used. The field was first ploughed in November and all stubbles were removed from the experimental field. Four ploughing and cross ploughing followed by laddering were given during land preparation to ensure good tilth. During the initial land preparation, only cowdung and at the final land preparation Urea (first of splits)(132g +13.2g), Triple Super Phosphate (TSP 15g) and Muroate of Potash (MP 9.6g), Zinc oxide(3.24g), Gypsum(13.44g) and Borax(1.63g) per plot of 1.2 m^2 were applied. The seeds of four interspecies (C_6 geneation lines) and 15 intraspecies (F_4 generation lines) progeny lines were sown in separate rows along with their parents to facilatate selection of appropriate types at a depth of 2.5 cm. The row size was 3.6 m. The distance between rows were 40 cm and between plants 5 cm for proper development and growth of plants. Intercultural operations such as thinning, weeding application of irrigation insecticides, etc. were done uniformly when necessary in order to maintain proper growth conditions. Data were taken from nine randomly selected plants of each progeny lines and three plants for

selfing in the same progeny lines. The selection was done on the basis of plants having bigger leaves, good pod formation, plant structure, canopy etc. This research was aiming to select plants with higher ploidy position and estimates of morphometric traits of those to compare with that of their parents. Data were recorded on days to 50% flowering, number of flowers set per plant (open), number of flowers set per plant (self), number of siliqua per plant (open), number of siliqua per plant (self), number of seeds per siliqua (open), number of seeds per siliqua (self), siliqua length (cm), beak length (cm), plant height at maturity, 1000-seed weight (g) from the sample plants. The recorded data were statistically analyzed using MSTAT-C, a computer based statistical package.

RESULTS AND DISCUSSION

In this study, there were phenotypic variations between Daulot and other genotypes. Daulot produced smaller beak length; less number of seeds per siliqua and 1000 seeds weight were also less than other genotypes. At the cross combination of the two species, it was found that the maximum number of days to 50% flowering was required for inter-species EG (*Brassica napus* x *Brassica juncea*) which is 4.79% higher than their parents. That indicates *B. juncea* which have had more control over this character when in cross combination with *B. napus*. In case of self pollination, inter-species EG (*B. napus* x *B. juncea*) progeny lines showed the better performance than their respective parents and other crosses in number of flower set per plant. *B. napojuncea* produced more siliqua in the other crosses and also produced more siliqua than the *B. napus* and *B. juncea* parents. In case of open pollination, crossed materials performed better than their parents. Number of flower set per plant and total number of siliqua per plant in EG (*Brassica napus* x *Brassica juncea*) and DE (*Brassica napus* x *Brassica napus*) progeny lines showed higher percentage over their parents. But the lowest total number of siliqua per plant was found in the cross ED (*Brassica napus* x *Brassica napus*) (2.66 siliqua per plant) and it showed 27.32% lower performance than their parents. Number of seeds per siliqua in open pollination was found and was comparatively 42.82% higher than the self-pollination. In case of open pollination, number of seeds per siliqua of crossed materials was much higher than their parents. This result proved that in the open pollination, the species are influenced by other species and for that they showed the higher number of seeds than the self-pollinated species. In case of siliqua, length of EG progeny lines showed the better performance than their respective parents and that was 19.93% higher than their parents. Inter-species EG progeny lines also showed better performance in beak length, plant height and 1000-seed weight and they showed 17.77%, 10.16% and 18.37% higher than their parents, respectively (Table 1).

The results of correlation coefficients among 1000-seed weight and yield contributing characters in all possible combinations were made for the inter and intra species genotypes and their parents are presented in Table 2. Out of 55 associations 10 associations were highly significant at the morphological level. The strong and positive associations between the characters suggested additive genetic model thereby less affected by environmental fluctuation. On the other hand 18 relationships were found negative and non-significant. The positive and non-significant association referred information of inherent relation among the pairs of combination. While the negative and non-significant association referred a complex linked of relation among pair of combinations. Number of flower set per plant (self) had highly significant positive correlation with total number of siliqua per plant (self) (r = 0.934**) and plant height (r = 0.546**).

Table 1. Performances of yield and yield components of intra and inter species *Brassica* progeny lines (EG (*Brassica napus* x *Brassica juncea*) ; DE (*Brassica napus* x *Brassica napus*) ; ED (*Brassica napus* x *Brassica napus*))

Serial No.	Progeny line	50 % flowering days	Self pollination			Open pollination						
			No. flower set per plant / day	Total no. siliqua per plant	No. seeds per siliqua	No. flower set per plant/day	Total no. siliqua per plant	No. seeds per siliqua	Siliqua length (cm)	Beak length (cm)	Plant height (cm)	1000- seed weight (gm)
Inter species lines												
1	EG$_1$	48	9.66	8.33	18.00	14.11	78.77	16.44	4.44	1.10	95.44	4.15
2	EG$_2$	47	10.66	8.66	18.00	11.00	88.77	29.22	4.31	1.03	95.66	3.76
3	EG$_3$	50	5.00	5.00	20.66	8.33	71.55	24.31	5.69	1.05	89.44	3.72
4	EG$_4$	52	7.33	6.33	22.66	11.44	66.88	19.00	4.95	1.05	102.00	4.10
Mean		49.25(4.79%)	8.16(81.33%)	7.08(70.19%)	19.83(18.50%)	11.22 (2.73%)	76.49 (6.71%)	22.24(5.55%)	4.85 (19.93%)	1.06 (17.77%)	95.64(10.16%)	3.93 (18.37%)
SD		2.22	2.53	1.73	2.27	2.37	9.54	5.69	0.63	0.03	5.13	0.22
CV%		4.502	30.973	24.393	11.424	21.092	12.465	25.584	12.911	2.824	5.363	5.691
Intra species lines												
5	DE$_1$	50	4.66	4.66	20.66	12.66	86.44	23.88	5.24	1.00	93.22	4.04
6	DE$_2$	47	4.00	3.00	12.66	13.22	96.55	29.60	6.16	1.04	87.44	3.75
7	DE$_3$	45	4.00	2.66	8.66	13.44	65.88	21.11	5.10	0.86	80.88	3.97
8	DE$_4$	50	5.00	4.33	20.66	9.00	74.77	21.75	5.77	1.13	97.77	3.77
9	DE$_5$	45	4.33	2.00	12.66	9.88	75.55	25.17	5.79	1.26	91.11	3.00
10	DE$_6$	46	4.00	3.33	13.33	11.55	86.22	25.35	5.81	1.19	96.77	3.19
11	DE$_7$	45	3.33	3.00	13.33	21.33	81.44	23.04	6.01	1.14	85.00	3.91
12	DE$_8$	47	4.00	3.33	12.00	19.33	69.44	25.54	5.85	0.94	86.77	3.26
13	DE$_9$	48	5.00	3.66	12.66	19.00	54.66	23.42	5.64	0.96	84.22	4.27
14	DE$_{10}$	59	4.66	4.00	14.66	9.11	60.66	21.13	5.44	0.94	89.33	3.25
Mean		48.20(7.11%)	4.30 (0.69%)	3.40 (7.10%)	14.13(50.70%)	13.85(41.62%)	75.16 (6.28%)	23.99(3.85%)	5.68 (18.89%)	1.05 (0.96%)	89.25(18.84%)	3.64 (2.67%)
SD		4.24	0.53	0.80	3.77	4.49	12.89	2.58	0.33	0.13	5.49	0.43
CV%		8.791	12.363	23.463	26.671	32.422	17.154	10.745	5.851	12.303	6.151	11.853
Intra reciprocal species lines												
15	ED$_1$	48	3.00	2.00	10.00	13.44	65.88	16.00	5.03	0.95	84.00	3.28
16	ED$_2$	50	3.66	1.33	6.00	15.11	56.33	25.24	5.30	0.78	72.55	4.06
17	ED$_3$	48	3.00	2.66	8.00	12.44	62.55	24.35	5.12	0.90	76.33	3.15
18	ED$_4$	50	3.66	3.33	10.00	13.44	44.88	20.48	5.36	0.96	73.44	3.47
19	ED$_5$	50	4.00	4.00	14.00	12.00	46.44	21.97	5.08	0.96	70.66	3.51
Mean		49.20(9.33%)	3.46(20.09%)	2.66(27.32%)	9.60 (66.50%)	13.29(35.80%)	55.22(21.92%)	21.61(6.45%)	5.18 (2.98%)	0.91 (12.5%)	75.40 (0.40%)	3.49 (6.68%)
SD		1.10	0.45	1.05	2.97	1.20	9.39	3.66	0.14	0.08	5.23	0.35
CV%		2.227	12.868	39.588	30.901	9.019	17.004	16.935	2.780	8.441	6.932	9.969
Parents line												
20	E	42	4.00	3.66	25.33	18.11	66.33	26.40	5.17	0.98	78.88	3.81
21	D	48	4.66	3.66	32.00	20.44	75.11	19.80	4.88	1.10	71.33	3.66
22	G	52	5.00	4.66	23.33	23.04	77.02	15.74	3.27	0.82	94.76	2.83
Total Mean		48.50	4.85	3.98	15.88	12.81	70.55	22.68	5.25	1.01	86.23	3.63
Total SD		3.39	1.95	1.83	6.45	3.41	13.33	3.81	0.65	0.19	9.36	0.41
Total CV %		6.992	40.235	45.948	40.621	26.657	18.894	16.797	12.373	11.719	10.856	11.150

Table 2. Correlation coefficients among yield related characters of 22 genotypes of *Brassica Spp.*

Characters	No. of flower set per plant (self)	Total no. siliqua per plant (self)	No. of seeds per Siliqua (self)	No. of flower set per plant (open)	Total no. siliqua per plant (open)	No. of seeds per Siliqua (open)	Siliqua length (cm)	Beak length (cm)	Plant height (cm)	1000 seed weight (gm)
50% flowering (days)	0.098	0.176	0.064	-0.252	-0.280	-0.384	-0.211	-0.302	0.162	-0.139
No. of flower set per plant (self)		0.934**	0.361	-0.172	0.328	-0.040	-0.473*	0.213	0.546**	0.349
Total no. siliqua per plant (self)			0.486*	-0.205	0.311	-0.111	-0.489*	0.199	0.553**	0.308
No. of seeds per Siliqua (self)				-0.454*	0.318	-0.197	-0.363	0.298	0.261	0.110
No. of flower set per plant (open)					-0.076	0.009	0.203	-0.194	-0.164	0.253
Total no. siliqua per plant (open)						0.305	0.020	0.488*	0.608**	0.011
No. of seeds per siliqua (open)							0.527*	0.164	-0.054	0.100
Siliqua length (cm)								0.404	-0.098	0.142
Beak length (cm)									0.422	-0.004
Plant height (cm)										0.010

* and ** indicate significant at 5% and 1% level of probability, respectively

Table 3. Relative ranking of genotypes on the basis of yield related trait

Serial No.	Genotypes	50% flowering (days) Mean	Rank	Self pollination No. flower set per plant Mean	Rank	Total no. of siliqua per plant Mean	Rank	No. of seeds per siliqua Mean	Rank	Open pollination No. flower set per plant Mean	Rank	Total no. of siliqua per plant Mean	Rank	No. of seeds per siliqua Mean	Rank	Siliqua length (cm) Mean	Rank	Beak length (cm) Mean	Rank	Plant Height (cm) Mean	Rank	1000-seed weight (gm) mean	Ran	Total Rank
1	EG_1	48	5	9.66	2	8.33	2	18.00	6	14.11	13	78.77	6	16.44	20	4.44	20	1.10	5	95.44	5	4.15	2	9
2	EG_2	47	4	10.66	1	8.66	1	18.00	6	11.00	5	88.77	2	29.22	2	4.31	21	1.03	8	95.66	4	3.76	10	1
3	EG_3	50	6	5.00	4	5.00	4	20.66	5	8.33	1	71.55	11	24.31	9	5.69	7	1.05	6	89.44	9	3.72	12	6
4	EG_4	52	7	7.33	3	6.33	3	22.66	4	11.44	6	66.88	13	19.00	19	4.95	18	1.05	6	102.0	1	4.10	3	6
5	DE_1	50	6	4.66	5	4.66	5	20.66	5	12.66	10	86.44	3	23.88	10	5.24	12	1.00	9	93.22	7	4.04	5	5
6	DE_2	47	4	4.00	7	3.00	10	12.66	10	13.22	11	96.55	1	29.60	1	6.16	1	1.04	7	87.44	11	3.75	11	4
7	DE_3	45	2	4.00	7	2.66	11	8.66	13	13.44	12	65.88	15	21.11	16	5.10	15	0.86	15	80.88	16	3.97	6	15
8	DE_4	50	6	5.00	4	4.33	6	20.66	5	9.00	2	74.77	10	21.75	14	5.77	6	1.13	4	97.77	2	3.77	9	2
9	DE_5	45	2	4.33	6	2.00	12	12.66	10	9.88	4	75.55	8	25.17	7	5.79	5	1.26	1	91.11	8	3.00	21	7
10	DE_6	46	3	4.00	7	3.33	9	13.33	9	11.55	7	86.22	4	25.35	5	5.81	4	1.19	2	96.77	3	3.19	19	3
11	DE_7	45	2	3.33	9	3.00	10	13.33	9	21.33	19	81.44	5	23.04	12	6.01	2	1.14	3	85.00	13	3.91	7	9
12	DE_8	47	4	4.00	7	3.33	9	12.00	11	19.33	17	69.44	12	25.54	4	5.85	3	0.94	13	86.77	12	3.26	17	12
13	DE_9	48	5	5.00	4	3.66	8	12.66	10	19.00	16	54.66	19	23.42	11	5.64	8	0.96	11	84.22	14	4.27	1	11
14	DE_{10}	59	8	4.66	5	4.00	7	14.66	7	9.11	3	60.66	17	21.13	15	5.44	9	0.94	13	89.33	10	3.25	18	13
15	ED_1	48	5	3.00	10	2.00	12	10.00	12	13.44	12	65.88	15	16.00	21	5.03	17	0.95	12	84.00	15	3.28	16	20
16	ED_2	50	6	3.66	8	1.33	13	6.00	15	15.11	14	56.33	18	25.24	6	5.30	11	0.78	17	72.55	20	4.06	4	16
17	ED_3	48	5	3.00	10	2.66	11	8.00	14	12.44	9	62.55	16	24.35	8	5.12	14	0.90	14	76.33	18	3.15	20	18
18	ED_4	50	6	3.66	8	3.33	9	10.00	12	13.44	12	44.88	21	20.48	17	5.36	10	0.96	11	73.44	19	3.47	15	19
19	ED_5	50	6	4.00	7	4.00	7	14.00	8	12.00	8	46.44	20	21.97	13	5.08	16	0.96	11	70.66	22	3.51	14	16
20	E	42	1	4.00	7	3.66	8	25.33	2	18.11	15	66.33	14	26.40	3	5.17	13	0.98	10	78.88	17	3.81	8	10
21	D	48	5	4.66	5	3.66	8	32.00	1	20.44	18	75.11	9	19.80	18	4.88	19	1.10	5	71.33	21	3.66	13	14
22	G	52	7	5.00	4	4.66	5	23.33	3	23.04	20	77.02	7	15.74	22	3.27	22	0.82	16	94.76	6	2.83	22	17

Note: EG (*Brassica napus* x *Brassica juncea*) ; **DE** (*Brassica napus* x *Brassica napus*) ; **ED** (*Brassica napus* x *Brassica napus*)

Table 4. Spearman's rank correlations among yield related characters of 22 genotypes of *Brassica spp*.

Characters	No. of flower set per plant (self)	Total no. siliqua per plant (self)	No. of seeds per siliqua (self)	No. of flower set per plant (open)	Total no. siliqua per plant (open)	No. of seeds per siliqua (open)	Siliqua length (cm)	Beak length (cm)	Plant height (cm)	1000 seed weight (gm)
50% flowering (days)	0.281	0.441*	0.252	-0.164	-0.309	-0.546**	-0.302	-0.317	0.103	-0.012
No. of flower set per plant (self)		0.817**	0.607**	-0.312	0.357	-0.188	-0.326	0.260	0.675**	0.291
Total no. siliqua per plant (self)			0.768**	-0.372	0.300	-0.208	-0.412	0.235	0.556**	0.263
No. of seeds per siliqua (self)				-0.563**	0.379	-0.220	-0.328	0.409	0.394	0.138
No. of flower set per plant (open)					-0.106	-0.074	0.103	-0.338	-0.287	0.313
Total no. siliqua per plant (open)						0.261	0.101	0.577**	0.625**	-0.005
No. of seeds per siliqua (open)							0.536*	0.120	-0.010	-0.031
Siliqua length (cm)								0.310	0.045	-0.097
Beak length (cm)									0.477*	0.118
Plant height (cm)										0.056

* and ** indicate significant at 5% and 1% level of probability, respectivel

Highly significant negative correlation was found between number of flower set per plant and siliqua length (r = -0.473*) (Table 2). Total number of siliqua per plant (self) had highly significant positive correlation with plant height (r = 0.553**) and significant negative correlation with number of flower set per plant (r = -0.454*). Significant positive correlation was found between total number of siliqua set per plant (self) and number of seeds per siliqua (self) (r = 0.486*) and significant negative correlation was found between total number of siliqua set per plant (self) and siliqua length (r = -0.489*) (Table 2). Non-significant positive correlation of number of seeds per siliqua (self) was found with beak length (r =0.298), plant height (r = 0.261) and 1000-seed weight (r = 0.110). Non-significant negative correlation of number of seeds per siliqua (self) was found with siliqua length (r = -0.363) (Table 2). Further, highly positive correlation was observed between total number of siliqua per plant (open) and plant height (r = 0.608**). Total number of siliqua per plant (open) had significant positive correlation with beak length (r = 0.488*). Kashyap and Mishra (2004), Mahak *et al.* (2003), Pant *et al.* (2002) reported positive and significant correlation between number of siliqua per plant and seed yield per plant. Number of seeds per siliqua (open) had highly significant positive correlation with siliqua length (r =0.527*) (Table 2). The present findings showed conformity with those of Pant et al. (2002). Lebowitz (1989) found siliqua length was positively correlated with number of seeds per siliqua (r = 0.602). Siliqua length had insignificant positive correlation with beak length (r = 0.404) and 1000-seed weight (r = 0.142) while insignificant negative correlation with plant height (r = -0.098). On the other hand, plant height positively correlated with beak length (r = 0.422) and 1000-seed weight (r = 0.010) while beak length had insignificant negative correlation with 1000-seed weight (r = -0.004) (Table 2). The genotypes ranked on the basis of individual score secured by each of the eleven characters. The total relative ranking ranged from 1 to 20 and the first rank was estimated for the genotype EG_2 followed by DE_2, DE_4 and DE_6 genotypes.

The last rank was estimated for the genotype ED_1 (Table 3). In order to compare the method of morphological characterization for distinguishing genotypes, this test was carried out (Table 4). Grouping of genotypes obtained through these rank correlation values were effective and repeatable. In this present study, the Spearman's rank correlation test presented 12 relationships that showed 10 positive significant and 2 negative significant correlations. In normal Coefficients of Correlation, 10 significant associations were found but 12 associations in Spearman's rank correlation. In this Spearman's rank correlation test, 50 % flowering days had significant positive correlation with number of siliqua per plant (self) (r_s = 0.441*) and also had significant negative correlation with number of seeds per siliqua (open) (r_s = -0.546**) (Table 4). But in the normal correlation this trait did not show any significant correlation. In these techniques, number of flower set per plant (self) had highly significant positive correlation with total number of siliqua per plant (r_s = 0.817**), number of seeds per siliqua (self) (r_s = 0.607**) and plant height (r_s = 0.675**). Highly significant positive correlation found in total number of siliqua per plant (self) with number of seeds per siliqua (self) (r_s = 0.768**) and plant height (r_s = 0.556**) and significant negative correlation with number of flower set per plant (open) (r_s = -0.563**) (Table 4). Total number of siliqua per plant (open) had highly significant positive correlation with plant height (r_s = 0.625**) and beak length (r_s = 0.577**), which showed the similar results in normal Coefficients of Correlation. Number of seeds per siliqua (open) and beak length both had showed the significant positive correlation in siliqua length (r_s = 0.536*) and

plant height (r_s = 0.477*), respectively. Among the cross products of C_7 and F_5 generations with their parents, inter-species EG_2 and EG_1 showed better agronomic performance. Phenotypic characters of the genotypes were closely associated with each other both normal Correlation Coefficients and Spearman's Rank Correlation Coefficients. The total relative ranking ranged from 1 to 20 and the first rank was estimated for the genotype EG_2 genotypes. The last rank was estimated for the genotype ED_1. Out of 55 associations, which found in the correlation study, 10 associations were found highly significant at the morphological level. This genetic study indicated that there is almost clearly defined variation in the parents and their cross, and reciprocal cross products. And definitely this research might have a remarkable impact to increase knowledge of plant breeders for future sustainable *Brassica spp.* breeding program.

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