International Journal of Agricultural Sciences
Volume **10** | Issue 1| January, 2014 | 286-290

RESEARCH PAPER

Early generation selection parameters in doubled haploids of Ethiopian mustard (*Brassica carinata* A. Braun)

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Abstract : The doubled haploids of Ethiopian mustard (*Brassica carinata* A. Braun) were evaluated along with mustard under two environments during *Rabi*, 2010-11. Analysis of variance for different traits such as days to flower initiation, days to 50 per cent flowering, days to 75 per cent maturity, plant height, number of primary branches per plant, number of secondary branches per plant, siliquae per plant, length of main shoot, siliquae on main shoot, siliqua length, seeds per siliqua, 1000-seed weight, seed yield per plant, biological yield per plant, harvest index and per cent oil content revealed the presence of sufficient genetic variability for all characters except siliqua length and per cent oil content in Env. I. On the other hand in Env. II, the presence of sufficient genetic variability for most of the traits was observed. Pooled analysis over environments revealed the presence of g x e interactions for all characters except days to flower initiation and per cent oil content. Correlation studies indicated the higher magnitude of genotypic correlations than their corresponding phenotypic correlations for most of the characters studied indicating the inherent association among the various characters. In pooled over the environments, at phenotypic level, the seed yield per plant had significant positive association with plant height, number of secondary branches per plant, siliquae per plant, biological yield per plant and harvest index. Based upon the path coefficient analysis, harvest index and biological yield per plant were observed to be the best selection parameters because of their high positive direct and indirect contributions towards seed yield per plant.

Key Words : Correlation, Ethiopian mustard, Genetic variability, Path co-efficient analysis

View Point Article : Rajesh, M., Senthil, T. and Prabakar, K. (2014). Characterization of seed borne *Fusarium* sp. biodiversity in major cereals through morphological and molecular basis. *Internat. J. agric. Sci.*, **10** (1): 286-290.

Article History : Received : 26.07.2013**; Revised :** 21.10.2013**; Accepted :** 19.11.2013

INTRODUCTION

Oilseed crops are the backbone of Indian agricultural economy and occupy an important position in daily diet, being a rich source of fats and vitamins. India is the second largest rapeseed-mustard growing country and accounts for 21.7% area in the world after China. Among oilseeds, rapeseed-mustard is the second most important oilseed crop of the country after groundnut and plays a significant role in Indian oil economy by contributing about 27.8% to the total oilseed production (Anonymous, 2010).

Rapeseed-mustard in general, has shown a declining trend both in acreage and production largely due to lack of suitable cultivars for different ecosystems, fluctuations in weather conditions, cultivation in marginal and sub marginal lands and prevalence of various biotic and abiotic stresses. The present day varieties are more susceptible to Alternaria blight and white rust. Hence, the most suitable alternate way to increase productivity is by adoption of high yielding, input responsive genotypes having resistance against various biotic and abiotic stresses. The success of any breeding programme depends upon the nature and magnitude of variability present in the germplasm stock. The chances of initiating an effective breeding programme are greater if more genetic variability is available with the plant breeder. The knowledge of associations among seed yield and its related traits and their direct and indirect contributions towards seed yield being a polygenic trait, is of prime importance in formulating

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suitable breeding methodology. Therefore, an attempt was made in the present study to estimate the nature and extent of genetic variability and character associations for seed yield and related traits in doubled haploids of Ethiopian mustard.

MATERIAL AND METHODS

The materials for the present investigation comprised of 33 genotypes including 28 doubled haploids (DH) obtained through anther culture technique; one advanced breeding line (P-138) and four (3 mustard and 1 karan rai) check varieties *viz.*, Nav Gold, RCC-4, Pusa Jaikisan and Jayanti. The doubled haploids were obtained from the cross Jayanti x RCC-6-1 developed in the Department of Agricultural Biotechnology, CSK HPKV, Palampur. All the genotypes were raised at the experimental farm of Department of Crop Improvement, CSK HPKV, Palampur in randomized complete block design with three replications in the plot size of $3.0 \times 0.60\ m^2$ on two different sowing dates *viz.*, 12th October, 2010 (Env. I) and 29th October, 2010 (Env. II). The row to row and plant to plant spacing were kept at 30cm and 15cm, respectively. The recommended cultural practices were followed to raise the crop. Data were recorded on various traits *viz.*, days to flower initiation, days to 50 per cent flowering, days to 75 per cent maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, siliquae per plant, length of main shoot (cm), siliquae on main shoot, siliqua length (cm), seeds per siliqua, 1000-seed weight (g), seed yield per plant (g), biological yield per plant (g), harvest index (%) and per cent oil content. The data were analysed statistically as per the method of Panse and Sukhatme (1985). The genotypic and phenotypic coefficients of correlations were computed as per Al-Jibouri *et al.* (1958) and path analysis was done as per Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance indicated the presence of sufficient genetic variability for all characters except siliqua length and per cent oil content in Env. I (Table 1). On the other hand in Env. II, the presence of sufficient genetic variability for days to flower initiation, days to 50 per cent flowering, days to 75 per cent maturity, plant height, number of primary branches per plant, number of secondary branches per plant, siliquae per plant, 1000-seed weight, seed yield per plant and harvest index was observed. Pooled analysis over environments revealed the presence of g x e interactions for all characters except days to flower initiation and per cent oil content (Table 2). The presence of g x e interaction has greatly influenced the variation due to genotypes to the extent that genotypic differences recorded in individual environments have vanished for these characters. Abebe (2008) observed significance differences for days to flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, seed yield per plant and per cent oil content. Zehra and Gukan (2009) also observed significant differences for plant height, number of branches per plant,

Table 1 : Analysis of variance for different characters of Brassica carinata in Env. I and Env. II

Sr. No.	Characters	Env. I		Env. II	
		Mean squares			
	Source	Genotypes	Error	Genotypes	Error
	df	32	64	32	64
1	Days to flower initiation	153.08**	10.87	203.82**	37.03
2	Days to 50% flowering	68.91**	8.33	198.81**	8.43
3	Days to 75% maturity	189.79**	8.94	119.96**	44.47
4	Plant height (cm)	2318.26**	207.41	226.03*	117.46
5	Number of primary branches /plant	2.60**	0.57	2.19**	1.08
6	Number of secondary branches /plant	7.44**	0.97	7.8**	3.92
7	Siliquae /plant	3703.66**	666.21	8929.05**	2579.37
8	Length of main shoot (cm)	127.24**	23.73	48.36	37.67
9	Siliquae on main shoot	180.78**	35.26	45.55	41.95
10	Siliqua length (cm)	0.263	0.217	0.23	0.160
11	Seeds /siliqua	2.36*	0.87	2.43	2.08
12	1000-seed weight (g)	1.15**	0.10	0.20*	0.11
13	Seed yield /plant (g)	7.36**	1.42	3.54**	1.47
14	Biological yield /plant (g)	140.18**	34.49	68.41	64.92
15	Harvest index (%)	44.47**	19.81	71.77*	39.51
16	Oil content (%)	11.54	12.56	12.75	15.50

* & and indicate significance of values at $P \leq 0.05$ and 0.01, respectively

number of pods per plant, pods per main stem, pod length, 1000-seed weight, seed yield per plant and per cent oil content in two environments. Yared *et al.* (2012) also observed highly significant differences for days to flower initiation and days to maturity in Ethiopian mustard.

At phenotypic level, significant positive correlation of seed yield per plant was observed with plant height, number of secondary branches per plant, siliquae per plant, biological yield per plant and harvest index (Table 3). On the other hand, seed yield per plant showed significant negative correlation with days to 75 per cent maturity which is a desirable association to be exploited directly through phenotypic selection. Significant positive correlations for seed yield with various characters have also been reported earlier by different workers such as plant height and number of secondary branches per plant (Ghosh and Gulati, 2001; Pant *et al.*, 2002), plant height and siliquae per plant (Patel *et al.*, 2001; Verma and Mahto, 2005), number of secondary branches per plant and siliqua per plant (Beena and Charjan, 2003; Chaudhary *et al.*, 2003) and biological yield per plant and harvest index (Sirohi *et al.*, 2008). Among other traits, significantly positive correlations were observed for days to flower initiation with days to 50 per cent flowering, days to 75 per cent maturity and number of primary branches per plant while it showed significant negative association with siliqua length and 1000-seed weight. Days to 50 per cent flowering exhibited significantly positive correlation with days to 75 per cent maturity and number of primary branches per plant and significant negative correlation with siliqua length and 1000-seed weight. Days to 75 per cent maturity recorded significant positive correlation with number of primary branches per plant and significant negative correlations with siliqua length, 1000-seed weight and biological yield per plant were observed. Significant positive associations of plant height were observed with number of primary branches per plant, siliquae per plant, seeds per siliqua and biological yield per plant whereas it showed significant negative correlation with siliquae on main shoot. Number of primary branches per plant exhibited significantly positive correlation with siliquae per plant. Number of secondary branches per plant also showed significant positive correlation with siliquae per plant and per cent oil content while significant negative association was observed with seeds per siliqua. Siliquae per plant were significantly and positively correlated with biological yield per plant while biological yield per plant exhibited significantly negative correlation with harvest index. Length of main shoot was positively and significantly correlated with siliquae on main shoot whereas siliquae on main shoot exhibited significantly negative correlation with 1000-seed weight. Siliqua length was positively and significantly correlated with 1000-seed weight and harvest index. At genotypic level, the estimates of correlation coefficients were generally higher to those observed at the phenotypic level for most of the traits. On the other hand, Kardam and Singh (2005) reported the phenotypic correlation coefficients to be higher in magnitude compared to genotypic correlation coefficients for most of the characters studied.

Path analysis at phenotypic (Table 4) revealed the high positive direct effects of biological yield per plant on seed yield per plant followed by harvest index. So, the seed yield can be increased through the direct selection for biological

Table 2 : Analysis of variance for different characters of *Brassica carinata* in pooled over the environments

Sr. No.	Characters	Mean Squares			
	Source	Genotypes	Environments	Genotype x environment (g x e)	Pooled error
	df	32	1	32	128
1.	Days to flower initiation	337.18**	255.68**	17.72	23.95
2.	Days to 50% flowering	235.09**	147.68**	32.63**	8.38
3.	Days to 75% maturity	264.37**	6.55	45.38**	10.21
4.	Plant height (cm)	1322.76	15254.73**	1221.53**	162.43
5.	Number of primary branches / plant	1.52	20.97**	3.27**	0.82
6.	Number of secondary branches / plant	7.57	250.26**	7.67**	2.44
7.	Siliquae /plant	7940.97	1426.19	4691.74**	1622.49
8.	Length of main shoot (cm)	90.82	955.68**	84.79**	30.70
9.	Siliquae on main shoot	93.19	3224.25**	133.14**	38.60
10.	Siliqua length (cm)	0.23	0.44	0.323*	0.20
11.	Seeds /siliqua	2.21	52.08**	2.58**	1.47
12.	1000-seed weight (g)	0.86*	0.19	0.48**	0.11
13.	Seed yield /plant (g)	3.64	0.05	7.25**	1.44
14.	Biological yield /plant (g)	105.19	251.16	103.41**	46.70
15.	Harvest index (%)	47.92	199.20	68.29**	29.70
16.	Oil content (%)	18.31**	81.08**	6.10	13.62

* and ** indicate significance of values at $P \leq 0.05$ and 0.01, respectively.

Table 3 : Estimates of correlation coefficients at phenotypic level among different characters in pooled over the environments

Characters	Days to flower initiation	Days to 50% flowering	Days to 75% maturity	Plant height	No. of primary branches/ plant	No. of secondary branches/ plant	Siliquae/ plant	Length of main shoot	Siliquae on main shoot	Siliqua length	Seeds/ siliqua	1000-seed weight	Biological yield/ plant	Harvest index	Oil content
Seed yield /plant	-0.028	0.028	-0.181*	0.242*	0.042	0.152*	0.140*	-0.079	-0.068	0.120	-0.074	0.053	0.190*	0.652*	-0.060
Days to flower initiation		0.699*	0.699*	0.030	0.231*	-0.004	0.033	0.078	0.078	-0.162*	-0.011	-0.511*	-0.096	0.074	0.014
Days to 50% flowering			0.631*	0.075	0.191*	0.019	0.026	0.044	-0.051	-0.200*	-0.050	-0.475*	-0.135	0.139	-0.104
Days to 75% maturity				0.027	0.181*	-0.046	-0.015	0.030	0.095	-0.262*	-0.083	-0.520*	-0.144*	-0.036	-0.045
Plant height					0.246*	-0.012	0.246*	-0.001	-0.150*	0.097	0.159*	0.001	0.246*	0.035	0.059
No. of primary branches/ plant						0.034	0.158*	0.877	-0.032	-0.012	0.046	-0.092	0.036	-0.031	0.070
No. of secondary branches/ plant							0.263*	0.112	0.123	-0.005	-0.146*	-0.032	-0.011	0.137	0.153*
Siliquae/ plant								0.075	-0.010	0.119	0.082	-0.065	0.176*	-0.023	0.048
Length of main shoot									0.379*	-0.082	0.016	-0.126	-0.047	-0.026	0.060
Siliquae on main shoot										-0.135	-0.074	-0.234*	0.039	-0.104	0.032
Silique length											0.053	0.268*	0.029	0.151*	0.136
Seeds/ silique												0.005	0.074	-0.109	-0.043
1000-seed weight													0.097	-0.020	0.066
Biological yield/ plant														-0.581*	-0.045
Harvest index															-0.018

* indicates significance of value at P≤0.05

Table 4 : Estimates of direct and indirect effects at phenotypic level of different characters on seed yield in pooled over the environments

Characters	Days to flower initiation	Days to 50% flowering	Days to 75% maturity	Plant height	Number of primary branches/ plant	Number of secondary branches/ plant	Siliquae/ plant	Length of main shoot	Silique on main shoot	Siliqua length	Seeds/ siliqua	1000-seed weight	Biological yield/ plant	Harvest index	Oil content
Days to flower initiation	-0.058	-0.040	-0.040	-0.002	-0.013	0.000	-0.002	-0.005	-0.005	0.009	0.001	0.030	0.006	-0.004	-0.001
Days to 50% flowering	0.001	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000
Days to 75% maturity	-0.007	-0.006	-0.010	0.000	-0.002	0.001	0.000	0.000	-0.001	0.003	0.001	0.005	0.001	0.000	0.000
Plant height	-0.007	-0.002	-0.001	-0.021	-0.005	0.000	-0.005	0.000	0.003	-0.002	-0.003	0.000	-0.005	-0.001	-0.001
Number of primary branches/ plant	0.015	0.012	0.012	0.016	0.065	0.002	0.010	0.006	-0.002	-0.001	0.003	-0.006	0.002	-0.002	0.015
Number of secondary branches/ plant	0.000	0.000	0.001	0.000	0.000	-0.011	-0.003	-0.001	-0.001	0.000	0.002	0.000	0.000	-0.002	0.000
Siliquae/ plant	0.001	0.001	0.000	0.005	0.003	0.005	0.020	0.002	0.000	0.002	0.002	-0.001	0.004	-0.001	0.001
Length of main shoot	-0.002	-0.001	-0.001	0.000	-0.002	-0.003	-0.002	-0.026	-0.010	0.002	0.000	0.003	0.001	0.001	-0.002
Siliquae on main shoot	0.002	-0.001	0.003	-0.004	-0.001	0.003	0.000	0.010	0.025	-0.003	-0.002	-0.006	0.001	-0.003	0.001
Siliqua length	0.006	0.007	0.009	-0.003	0.000	0.000	-0.004	0.003	0.005	-0.036	-0.002	-0.010	0.001	-0.005	-0.005
Seeds/ siliqua	0.000	0.000	0.001	-0.001	0.000	0.001	-0.001	0.000	0.001	-0.001	-0.009	0.000	-0.001	0.001	0.000
1000-seed weight	0.011	0.010	0.011	0.000	0.002	0.001	0.001	0.003	0.005	-0.006	-0.001	-0.022	-0.002	0.000	-0.001
Biological yield/ plant	-0.083	-0.116	-0.124	0.211	0.031	-0.009	0.151	-0.040	0.033	-0.025	0.063	0.083	0.859	-0.188	-0.039
Harvest index	0.086	0.162	-0.042	0.041	-0.036	0.160	-0.026	-0.030	-0.121	0.176	-0.127	-0.023	-0.677	0.855	-0.021
Oil content	0.000	-0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.005
Correlation with seed yield /plant	-0.028	0.028	-0.181*	0.242*	0.042	0.152*	0.140*	-0.079	-0.068	0.120	-0.074	0.053	0.190*	0.652*	-0.060

Residual effects (P) = 0.28   * indicates significance of value at P=0.05   The bold values indicate direct effects yield per plant and harvest index. The results are in conformity with the earlier findings of Sirohi *et al.* (2008) and Kumari and Kumari (2012). The direct effects of remaining traits on seed yield per plant were observed to be less. The significant negative correlation of seed yield per plant with days to 75 per cent maturity was mainly due to its highest negative indirect effects *via* biological yield per plant followed by harvest index and days to flower initiation, counter balanced by number of primary branches per plant and 1000-seed weight to a lesser extent. Significant positive correlation of plant height with seed yield per plant was mainly contributed by its high positive indirect effect *via* biological yield per plant followed by harvest index, though; its own direct effect counter balanced the indirect effects to a lesser extent. The significant positive correlation of number of secondary branches per plant with seed yield per plant was only due to its positive indirect effect *via* harvest index. The significant positive association of siliquae per plant with seed yield per plant was mainly due to its highest positive indirect effects *via* biological yield per plant, though, its own direct effect was counter balanced by harvest index to a lesser extent. Therefore, the results from present study indicated that biological yield per plant and harvest index would be the best selection indices for increasing seed yield per plant in *Brassica carinata*. The residual effect (0.28) was found to be low which indicated that some additional imperative traits should also be included as 72 % of the variability has been explained by the traits studied in present study.

REFERENCES

Abebe, D. (2008). Genetic variability and association among seed yield and yield related traits in Ethiopian mustard (*Brassica carinata* A. Braun). M.Sc. Thesis. Department of Plant Breeding, Harmaya University, Dire Dawa, Ethiopia. p 75.

Al-Jibouri, H.A., Millar, P.A. and Robinson, H.F. (1958). Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. *Agron. J.,* **50**(9): 633-636.

Beena, N. and Charjan, S.U. (2003). Path analysis in mustard (*Brassica juncea* L.). *J. Soils Crops,* **13**(1): 168-169.

Chaudhary, V.K., Rakesh, K. and Sah, J.N. (2003). Path analysis in Indian mustard. *J. App. Bio.,* **13**(1/2): 6-8.

Dewey, D.R. and Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.,* **51**(3): 515-518.

Ghosh, S.K. and Gulati, S.C. (2001). Genetic variability and association of yield components in Indian mustard (*Brassica juncea* L.). *Crop Res.,* **21**(3): 345-349.

Kardam, D.K. and Singh, V.V. (2005). Correlation and path analysis in Indian mustard [*Brassica juncea* (L.) Czern. & Coss.] grown under rainfed condition. *J. Spices Aro. Crops,* **14**(1): 56-60.

Kumari, A. and Kumari, V. (2012). Exploitable genetic variability and character association studies in Indian mustard (*Brassica juncea*), 1st National *Brassica* Conference (March 2-3, 2012) held at CCSHAU, Hisar p 54-55.

Panse, V.G. and Sukhatme, P.V. (1985). *Statistical methods for agricultural workers*. Indian Council of Agricultural Research, New Delhi, India.

Pant, S.C., Singh, P., Kumar, R., Mishra, S. and Singh, S.P. (2002). Correlation and path analysis in Indian mustard. *Plant Arch.,* **2**(2): 207-211.

Patel, K.M., Patel, P.G. and Pathak, H. (2001). Path analysis in Indian mustard [*Brassica juncea* (L.) Czern. & Coss]. *Madras Agric. J.,* **87**(4/6): 330-331.

Sirohi, S.P.S., Gaurav, S.S., Sanjai, M., Sirohi, S. and Meenakashi (2008). Correlation and path analysis of Indian mustard [*Brassica juncea* (L.) Czern. & Coss.]. *Prog. Agric.,* **8** (1): 89-92.

Verma, A.K. and Mahto, J.L. (2005). Correlation and causation study in Indian mustard. *J. Res.,* **17**(1): 91-94.

Yared, S. B., Wolde, M. T., Yohannes and Wami, T. D. (2012). Analysis of genetic parameters for some agronomic traits of introduced Ethiopian mustard (*Brassica carinata* A. Braun) genotypes. *Internat. J. Agric. Res.,* **7** (3): 160-165.

Zehra, A. and Gukan, K. (2009). Genetic variability and association studies of some quantitative characters in winter rapeseed (*Brassica napus* L.). *Afri. J. Biotech.,* **8** (15): 3547-3554.

■ **WEBLIOGRAPHY**

Anonymous (2010). FAO Production year book, Rome, Italy: FAO. http://faostate.fao.org. [19th June, 2012].