JOURNAL OF AGRICULTURE AND BASIC SCIENCES
ISSN Online: 2518-4210
http://www.jabsjournal.com/

Full Length Research Article

Correlation and path coefficient studies in elite lines of rapeseed (*Brassica napus* L.)

Ejaz-ul-Hasan, Hafiz Saad Bin Mustafa*, Mariam Hassan, Tariq Mahmood and Sultan Salah-ud-Din
Oilseeds Research Institute (AARI) Faisalabad, Pakistan.
*Corresponding author's email: saadpbg@gmail.com

Abstract

The aim of current research was to understand, the better selection criteria for the maximum production in *Brassica napus* L. Eight different genotypes were cultivated at Oilseeds Research Farm, Ayub Agricultural Research Institute, Faisalabad, Pakistan during winter 2014-2015. The data was recorded for traits days to 50% flowering, days to maturity, plant height, branches per plant, siliqua length, seeds per siliqua, 1000 seed weight, seed yield per plant, silique per plant and seed yield per plot. Mean values, genotypic variance, phenotypic variance, genotypic coefficient of variation, phenotypic coefficient of variation and broad sense heritability were computed. Correlation (genotypic and phenotypic) and path analysis, were also calculated. Seed yield per plant and silique per plant showed highest genotypic and phenotypic variance. Days to flowering had maximum broad sense heritability. Days to flowering, days to maturity, plant height, silique length, seed yield per plant and silique per plant were the main characters which were significantly positive correlated with seed yield per plot in rapeseed. Path analysis showed that siliqua length had a maximum positive direct effect on seed yield per plot in *B. napus* L. Rapeseed breeders should emphasis on aforesaid positively correlated traits to develop high yielding rapeseed cultivars.

Keywords: *Brassica napus*, genotype, heritability, path analysis, silique, variance.
Received: 21-08-2016, Accepted: 28-09-2016

Introduction

Rapeseed (*Brassica napus* L.) is an amphidiploid crop with genome AACC, 2n=38 and emerged by particular hybridization between diploid *Brassica rapa* L. (AA genome, 2n=20) and *Brassica oleracea* L. (CC genome, 2n=18) (Prakash and Hinata, 1980). *Brassica napus* is second most significant oilseed product in the worldwide oil seed market after soybean and critical wellspring of vegetable oil (Hasan *et al.*, 2006).

The production of edible oil in Pakistan is not satisfactory to meet the current requirement of the country due to increase in demand and production gap. (Fazal *et al.*, 2015). Consequently, a massive amount of foreign exchange is waste annually on its import to fulfill the requirement. (Hasan *et al.*, 2015). During the year 2013-2014, the local production was 0.573million tonnes against the 3.20 million tonnes total needed for edible oil/oilseeds and 2.627 million tonnes edible oil was imported which worth US$ 2.50 billion (Anonymous, 2015). Therefore, it is essential to take imperative measures to enhance the yield capability of oilseed crops in the country.

Seed yield is intricate trait and is subject to abundant different phenotypical attributes which are actually quantitative in nature (Shah *et al.*, 2000). There is a need for more attention for yield contributing traits that have the great effect on production of crops (Tuncturk and Ciftci, 2007).

The importance of genotypic and phenotypic variability, heritability and trait association have demonstrated by numerous researchers (Ali *et al.*, 2002; Lekh *et al.*, 1998; Saini and Sharma, 1995) for further hereditary change. Gosh and Gulati (2001) additionally demonstrated that the attributes demonstrating high heritability are controlled by added substance qualities and may be effectively used for crops choice on the premise of morphological presentation. Sandhu and Gupta, 1996 reported positive and critical relationships of seed weight with plant height. Khubli and Pant (1999) demonstrated a positive association of seed yield with number of silique per plant, 1000 seed weight in Indian mustard. The basic association analysis couldn't completely clarify the association among the traits. Consequently, the path coefficient analysis is recommended to endeavor for highly precise measurement of effect of the independent variable on the dependent one (Korkut *et al.*, 1993). 1000 seed weight and days to maturity has positive direct impact on yield (Khayat *et al*., 2012; Shalini *et al*., 2000). Sinha *et al.,* 2001 reported that siliqua length had a positive direct impact on yield per plant.

The present experiment was desired to evaluate heritability, genotypic and phenotypic relationship among different traits to determine yield contributing traits in rapeseed (*Brassica napus*) for selection and further utilization in breeding program to develop high yielding rapeseed cultivars. This may ultimately increase the local production of edible oil in the country and decrease the huge import bill.

Materials and methods

The research was carried out at Oilseeds Research Farm, Ayub Agricultural Research Institute, Faisalabad, Pakistan, during 2014-2015. Total Eight genotypes of rapeseed including seven elite strains (KN-256, RBN-04725, RBN-05075, RBN-08002, RBN-09029, RBN-09038, RBN-09011) and one check variety (Faisal canola) having diverse genetic makeup were chosen for the experiment. These genotypes were cultivated in randomized complete block design (RCBD) having three replications. Manual seed drill was used for the sowing of seeds keeping 45cm distance between rows. The plot consists of three rows of each entry with five meters length. All recommended agronomic and cultural practices were practiced during the whole tenure of experiment.

The plants were randomly selected and tagged for data collection of days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, siliqua length (cm), number of seeds per siliqua, 1000 seed weight (g), number of silique per plant, seed yield per plant and seed yield per plot (g). These traits were evaluated by using the analysis of variance (ANOVA), as devised by Steel and Torrie (1980). The formula of Falconer (1989) was used to estimate the heritability. Kwon and Torrie (1964) method was used to find the Genotypic (r_g) and phenotypic (r_p) correlation. Dewey and Lu, (1959) method was used for the analysis of path coefficient. Thus, the coefficient analysis was computed by using yield per plot (g) as dependent variable and other experimental characters as independent variables in this experiment.

Results and Discussion

Any enhancement or change in a character depends on the rate of genetic variability that is heritable for that character. The study of estimation of variability in the given population in the terms of yield and its heritable parts is essential for any program of breeding, targeting to increase the yield and other specific characters. The data (Table-1) exhibited that genotypic mean square for each characteristic was highly significant. The range of morphological variability assessed for the characters shown in trials gave us the data that these characters should be engaged for the development of new high yielding cultivars of *Brassica napus* L.

Heritability in the broad sense (h^2B.S) was calculated for various traits observed in experiment. In Table-2 high heritability was calculated for days to flowering (0.99) followed by plant height (0.98). Maximum phenotypic and genotypic variance was calculated for seed yield/plot was 132753.59 and 121210.85. Maximum phenotypic and genotypic coefficient of variance for silique per plant were 20.50 and 18.95 respectively.

The study of correlation coefficient indicated the nature of the association between yield contributing attributes. Study of correlation has deep attentions for plant breeders in investigating the characters that are associated with key breeding objectives. The phenotypic and genotypic correlations between the ten traits are concise in Table-3 at 1% to 5% significance level. Days to flowering had highly significant and positive genotypic correlation with days of maturity (0.926), plant height (0.925), siliqua length (0.609), silique per plant (0.868) and seed yield per plot (0.522). Days to maturity had highly significant and positive genotypic correlation with plant height (0.821), siliqua length (0.585), siliqua per plant (0.925) and seed yield per plot (0.555). Plant height had significant and positive genotypic correlation with siliqua length (0.802), seed yield per plant (0.764), siliqua per plant (0.806) and seed yield per plot (0.675). Branches per plants had significant and positive genotypic correlation with seeds per silique (0.686) and 1000 seed weight (0.734). Siliqua length had significant and positive genotypic correlation with seed yield per plot (0.785), siliqua per plant (0.749) and seed yield per plot (0.848). Seeds per silique had a significant positive genotypic association with 1000 seed weight (0.891) and seed yield per plant (0.546). 1000 seed weight had a significant positive genotypic association with seed yield per plant (0.660). Positive significant genotypic correlation was found between seed yield per plot and seed yield per plant (0.523). The positive significant genotypic correlation was also found between siliqua per plant and seed yield per plot (0.730). Highly positive correlation found between Plant height and yield per plant by Korkut *et al.,* (1993).

Days to flowering had highly significant and positive phenotypic correlation with days of maturity (0.911), plant height (0.913), siliqua length (0.519), silique per plant (0.794) and seed yield per plot (0.501). Days to maturity had highly significant and positive phenotypic correlation with plant height (0.799), siliqua length (0.461), siliqua per plant (0.837) and seed yield per plot (0.518). Plant height had significant and positive phenotypic correlation with siliqua length (0.658), seed yield per plant (0.763), siliqua per plant (0.741) and seed yield per plot (0.654). Branches per plants had significant and positive phenotypic correlation with seeds per silique (0.602) and 1000 seed weight (0.693). Siliqua length had significant and positive phenotypic correlation with seed yield per plot (0.705), siliqua per plant (0.550) and seed yield per plot (0.674). Seeds per silique had a significant positive phenotypic association with 1000 seed weight (0.661) and seed yield per plant (0.483). 1000 seed weight had a significant positive phenotypic association with seed yield per plant (0.292). Positive significant phenotypic correlation was found between seed yield per plot and seed yield per plant (0.429). The positive significant phenotypic correlation was also found between siliqua per plant and seed yield per plot (0.697). Tahira *et al.,* (2011) also found that siliqua length had significant and positive correlation with the seed yield per plant. The number of pod had a close relationship with grain yield in rapeseed (Miri, 2007).

The data in Table-4 stated that strong positive effect of siliqua length (0.638) as the unit increase in length of siliqua the number of seeds per siliqua were also added, followed by siliqua per plant (0.448), seed yield per plant (0.406), 1000 seed weight (0.399), days to maturity (0.222) and plant height (0.158). A positive direct effect of 1000 seed weight and days to maturity on seed yield was observed by Khayat *et al.,* (2012). Sinha *et al.,* 2001 reported that siliqua length had a positive direct effect on yield per plant. Photosynthesis is the main yield contributing factor, the relationship between photosynthetic rate and grain yield is complicated, (Chango & McVetty, 2001). Photo-synthetically active silique wall in *Brassica* contributes assimilates and nutrients to fuel seed growth (Bennett *et al.*, 2011).

Conclusion

In any crop breeding program physical and genetic variability of breeding material has a vital role to develop high yielding and stable cultivar that’s resilient to environmental conditions. Correlation and path coefficient analysis are the best statistical tools which will be helpful to decide the traits that contributed in the seed yield of rapeseed crop. The genotypes having high seed yield per plant, more number of silique per plant and have long siliqua length must be used in crossing program with disease resistant lines to develop future high yielding disease resistant rapeseed cultivar.

References

Ali, N., F. Javidfar and A.A. Attary. (2002). Genetic variability, correlation and path analysis of yield and its components in winter rapeseed (*Brassica napus* L.). *Pak. J. Bot.,* 34:145-150.

Anonymous, 2015. Economic survey of Pakistan. 2014-15. Ministry of Finance, Government of Pakistan, pp. 29-30.

Bennett, E.J., J.A. Roberts and C. Wagstaff. (2011). The role of the pod in seed development: strategies for manipulating yield. New Phytologist. 190: 838–853.

Chango, G. and P.B.E. McVetty. (2001). Relationship of physiological characters to yield parameters in oilseed rape. *Can. J. Plant Sci.*, 81: 1–6

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

Falconer, D.S. (1989). Introduction to quantitative genetics. 3rd Edn. Long Man Scientific and Technical, UK.

Fazal, A., H.S.B. Mustafa, E. Hasan, M. Anwar, M.H.N. Tahir and H.A. Sadaqat. (2015). Interrelationship and path coefficient analysis among yield and yield related traits in sesame (*Sesamum indicum* L.). *Nat. Sci.,* 13(5):27-32.

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

Hasan M., F. Seyis, A.G. Badani, J. Pons-Kühnemann, W. Friedt, W. Lühs, R.J. Snowdon. (2006). Analysis of genetic diversity in the *Brassica napus* L. gene pool using SSR markers. *Genet. Resour. Crop Evol.,* 53: 793-802.

Hasan, E., T. Bibi, H.S.B. Mustafa, T. Mahmood, M.T.A. Kalyar and J. Salim. (2015). Genetic evaluation and characterization for yield and related traits in mustard (*Brassica juncea* L.). *Res. J. Agri. Environ. Manag.,* 4(2):82-87.

Khayat, M., S. Lack and H. Karami. (2012). Correlation and path analysis of traits affecting grain yield of canola (*Brassica napus* L.) varieties. *J. Basic. Appl. Sci. Res.*, 2(6):5555-5562.

Khubli S.K. and D.P. Pant (1999). Correlation and path coefficient analysis of yield and its components in Indian mustard. *Crop Res. Hisar*, 17:371- 375.

Korkut, Z.K.İ. Baser and S. Bilir. (1993). The studies path coefficient and correlation of drum wheat’s. Symposium of Durum Wheat and Its Products, Ankara, 183-87.

Kwon, S.H. and J.H. Torrie. (1964). Heritability and interrelationship among traits of two soybean population. *Crop Sci.,* 4: 196-198.

Lekh R., S. Hari, V.P. Singh, L. Raj, H. Singh. (1998). Variability studies in rapeseed and mustard. *Ann. Agri. Res.,* 19(1):87-88.

Miri, H.R. (2007). Morpho-physiological Basis of Variation in Rapeseed (*Brassica napus* L.) Yield. *Int. J. Agri. Biol.,* 9(5): 701–706.

Prakash S. and K. Hinata. (1980). Polyphyletic origins of *Brassica napus*: new evidence based on organelle and nuclear RFLP analysis. *Genome.* 35: 992-1001.

Saini H.P. and Sharma (1995). Model plant architecture through association and path coefficient analysis in Indian Colza. *Indian J. Agri. Res.*, 29:109–115.

Sandhu S.K. and V.P. Gupta. (1996). Genetic divergence and correlation studies in *Brassica* species*. Crop Imp.,* 23:253-256.

Shah A.H., M.M. Gilani, F.A. Khan. (2000). Comprehensive selection of yield and yield influencing characters in *Brassica* species. *Int. J. Agri. Biol.,* 2(3):245-247

Shalini S., R.A. Sheriff, R.S. Kulkarni, P. Venkantarmana. (2000). Correlation and path analysis of Indian mustard germplasm. *Res. Crops India,* 1:226- 229.

Sinha P., S.P. Singh and I.D. Pandey. (2001). Character association and path analysis in *Brassica* species. *Indian J. Agric. Res.,* 35(1): 63-65.

Steel R.G.D and J.H. Torrie. (1980). Principles and Procedures of statistics. A Biometrical approach, McGraw Hill Book Co., New York, USA.

Tahira T. Mahmood, M.S. Tahir, U. Saleem, M. Hussain and M. Saqib. (2011). The estimation of heritability, association and selection criteria for yield components in mustard *(Brassica juncea*). *Pak. J. Agri. Sci.,* 48(4): 251-254.

Tuncturk, M. and V. Ciftci. (2007). Relationships between yield and some yield components in rapeseed (*Brassica napus* ssp. *Oleifera* L.) cultivars by using correlation and path analysis. *Pak. J. Bot.,* 39(1): 81-84.

Table 1: Mean values for different yield related traits of *Brassica napus* genotypes during winter 2014-2015

Genotypes	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches /plant	Siliqua length (cm)	Seeds/ Siliqua	1000 seed wt.(g)	Seed yield /plant (g)	Silique /plant	Seed yield /plot (g)
KN-256	77.67	153.67	178.00	9.27	7.01	25.13	3.63	18.93	353.00	2264.33
RBN-04725	67.00	146.33	165.80	8.07	7.45	26.00	3.77	14.49	264.67	1886.67
RBN-05075	74.67	147.00	193.87	7.60	7.40	25.54	3.87	21.68	299.67	2449.00
RBN-08002	74.33	149.67	183.13	7.27	6.61	20.80	3.67	14.97	264.67	1694.00
RBN-09029	68.33	148.33	174.47	6.87	7.29	18.53	3.30	17.71	336.00	2232.33
RBN-09038	68.00	150.67	174.40	6.47	7.28	26.29	4.03	20.68	300.33	2475.33
RBN-09011	46.67	136.00	103.33	10.07	6.11	30.94	4.77	20.83	171.00	1553.67
Faisal Canola	72.33	150.33	158.53	7.13	6.75	17.40	3.73	16.75	303.00	1812.33
Mean square	278.52**	83.50**	2287.58**	4.61**	0.65**	61.95**	0.55**	22.38**	9344.20**	375175.0**

**=highly significant (P<0.01)

Table 2: Genetic parameters for different yield related traits of *Brassica napus* genotypes during winter 2014-2015

Genetic parameters	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches /plant	Siliqua length (cm)	Seeds/ siliqua	1000 seed wt.(g)	Seed yield /plant (g)	Silique /plant	Seed yield /plot (g)
Genotypic variance	92.61	27.60	758.78	1.43	0.19	20.20	0.15	7.01	2947.19	121210.85
Phenotypic variance	93.30	28.31	770.03	1.75	0.28	21.91	0.26	8.37	3449.80	132753.59
Genotypic coefficient of variation (%)	14.02	3.56	16.56	15.25	6.24	18.86	1.26	14.5	18.95	17.02
Phenotypic coefficient of variation (%)	14.08	3.6	16.67	16.87	7.57	19.64	1.66	15.84	20.50	17.81
Heritability in broad sense ($h_{2B.S}$)	0.99	0.97	0.98	0.82	0.68	0.91	0.57	0.84	0.85	0.91

Table-3: Genotypic (r_g) and Phenotypic (r_p) correlation coefficients for different yield related traits

		Days to 50% flowering	Days to maturity	Plant height (cm)	Branches /plant	Siliqua length (cm)	Seeds/ siliqua	1000 seed wt.(g)	Seed yield /plant (g)	Silique /plant
Days to maturity	r_g	0.926**								
	r_p	0.911**								
Plant height (cm)	r_g	0.925**	0.821**							
	r_p	0.913**	0.799**							
Branches/plant	r_g	-0.531**	-0.584**	-0.660**						
	r_p	-0.471*	-0.502*	-0.607**						
Siliqua length (cm)	r_g	0.609**	0.585**	0.802**	-0.625**					
	r_p	0.519**	0.461*	0.658**	-0.440*					
Seeds/siliqua	r_g	-0.594**	-0.602**	-0.474*	0.686**	-0.243				
	r_p	-0.564**	-0.560**	-0.456*	0.602**	-0.096				
1000 seed wt.(g)	r_g	-0.895**	-0.888**	-0.886**	0.734**	-0.701**	0.891**			
	r_p	-0.695**	-0.648**	-0.654**	0.693**	-0.510*	0.661**			
Seed yield /plant (g)	r_g	-0.278	-0.270*	-0.764**	0.209	0.785**	0.546**	0.660**		
	r_p	-0.251	-0.263*	-0.763**	0.201	0.705**	0.483*	0.292*		
Silique /plant	r_g	0.868**	0.925**	0.806**	-0.504**	0.749**	-0.588**	-0.966**	-0.070	
	r_p	0.794**	0.837**	0.741**	-0.464*	0.550**	-0.563**	-0.683**	-0.063	
Seed yield /plot (g)	r_g	0.522**	0.555**	0.675**	-0.448*	0.848**	-0.004	-0.450*	0.523**	0.730**
	r_p	0.501**	0.518**	0.654**	-0.400*	0.674**	-0.053	-0.306*	0.429*	0.697**

*=significant (P<0.05), **=highly significant (P<0.01)

Table-4: Direct and indirect effect in Path coefficient analysis

	Indirect effects									Direct effects
	1	2	3	4	5	6	7	8	9	
1. Days to 50% flowering		0.206	0.146	0.305	0.389	0.012	-0.357	-0.113	0.388	-0.180
2. Days to maturity	-0.167		0.130	0.034	0.373	0.013	-0.354	-0.110	0.414	0.222
3. Plant height (cm)	-0.167	0.183		0.038	0.512	0.010	-0.354	-0.067	0.361	0.158
4. Branches/plant	0.096	-0.130	-0.104		-0.399	-0.014	0.292	0.093	-0.226	-0.057
5. Siliqua length (cm)	-0.110	0.130	0.127	0.036		0.005	-0.280	-0.035	0.335	0.638
6. Seeds/ siliqua	0.107	-0.133	-0.074	-0.039	-0.155		0.355	0.222	-0.264	-0.021
7. 1000 seeds wt.(g)	0.161	-0.198	-0.140	-0.042	-0.447	-0.019		0.268	-0.433	0.399
8. Seed yield /plant (g)	0.050	-0.060	-0.026	-0.013	-0.055	-0.011	0.263		-0.032	0.406
9. Silique /plant	-0.156	0.206	0.127	0.029	0.478	0.012	-0.386	-0.029		0.448