Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(1): 1678-1681
Received: 18-11-2017
Accepted: 19-12-2017

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Correlation and path analysis in Indian mustard (*Brassica juncea* L.) in agro – climatic conditions of Jhansi (U.P.)

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Abstract
An investigation was undertaken to study the correlation and path analysis of thirteen quantitative traits in 12 Indian mustard (Brassica *juncea* L.) germplasm lines. The experiment material was evaluated in a randomized block design with three replications. Analysis of variance ratios of all the characters were found highly significant. Coefficient of variation for GCV and PCV were found high for the following traits i.e. biological yield per plant, grain yield per plant and silliqua on main raceme. Biological yield per plant, silliqua on main raceme, grain yield per plant and number of seed per silliqua exhibited higher heritability and higher genetic advance. Correlation study revealed that biological yield per plant and silliqua on main raceme exerted high positive significant genotypic correlation with grain yield per plant and secondary branches per plant was found negatively correlated with grain yield per plant. path analysis revealed that days to 50 % flowering showed maximum positive direct effect however the highest indirect effect of this trait was exhibited through biological yield per plant.

Keywords: Genetic variability, correlation and path analysis, Mustard (Brassica *juncea* L.)

Introduction

Mustard is the third most important source of edible oil of the world after soyabean and palm. In India it ranks second in acreage superseded by groundnut only. Mustard crop is grown both in tropical and subtropical countries. Out of seven edible oilseed crops cultivated in India, rapeseed mustard occupies second position in area and production next to groundnut sharing 27.80% in the Indias oilseed economy and countries 28.60 % in the total oilseeds production (Shekhawat *et. al.* 2012) [8]. Indian mustard (Brassica juncea (L.) is an important Rabi season crop extensively grown as under irrigated condition. Yield is complex character which dependent on the various yield contributing traits. Thus the study of correlation between yield and its component is of primary importance in formulating the selection criteria under crop improvement. Selection of any desirable trait is generally preformed based on the phenotypic value of the plants. Which is partly determined by genotypes? Which is heritable and partly by environment which is non heritable. Therefore, it is necessary to know the various components of the yield and its mutual correlation with other independent traits. This is because, selection would be more efficient if it is based on some components which less sensitive to environment. It is well known that correlation mainly does not fulfill the purpose of the researcher because it does not detect the characters having indirect effects on seed yield. In such situation path coefficient analysis developed by Wright (1921) [21] put forward the real importance of such characters of partitioning the correlation coefficient in to direct as well as indirect effects. The correlation between two characters can be partitioned into a portion that is due to genetic cause and the other due to environmental factors.

Materials and Methods

The present field experiment was conducted at Field Experimental center Department of Genetics & Plant Breeding, Institute of Agricultural Sciences, Bundelkhand University Jhansi (UP) in Randomized block design (RBD) with three replications. The mustard crop was shown on 15.10.2015 and recommended packages of practices were followed with twelve genotypes of Indian mustard during Rabi 2015-2016. Observations were recorded on five randomly selected plants in each genotype and replication for different thirteen traits. These traits were computed on basis of mean data after computing for each character was subjected to standard method of analysis of variance following Panse and Sukhatme (1978) [13] phenotypic and genotypic coefficient of variation, heritability (Broad Sense) and genetic advance as percent of mean were estimated by the formula al suggested by Burton (1952) [3] and Johanson *et. al.* (1955).

The genotypic correlation coefficients were estimated according to the formula given by Al-Jibouri *et. al.* (1958) [1] while path analysis was carried out using the genotypic correlation coefficient to know direct and indirect effects of the components on yield as suggested by Wright (1921) [20] and illustrated by Dewey and Lu (1957) [6].

Result and Discussion

The analysis of variance revealed significant differences among the twelve genotypes for all the thirteen quantitative traits presented in Table-1. The perusals of data revealed that phenotypic variance were higher than the corresponding genotypic variance for all the traits studies. Which indicated the influences of environmental factor on these traits. Data presented in Table- 2 showed maximum GCV and PCV was recorded for biological yield per plant (23.28 and 23.80) followed by grain yield per plant (21.77 and 27.58) these results were well sported by similar findings by Kumar *et. al.* (2006) [9], Singh *et.al.* (2011) [18], Shekhawat *et al.* (2012) [8], Kumar *et. al*. (2006) [9] and Mondal & Khajuria (2000) [12] reported high values for PCV and GCV for the biological yield per plant and grain yield per plant. These traits suggested the possibility of yield improvement through selection. High heritability (board sense) was observed for plant height (97%) followed by biological yield per plant (96 %), silliqua on main raceme (95%) and fruiting branch length (84 %), high estimates of heritability was reported for plant height (Chaudhry and Sharma, 1982) [5]. High magnitude of heritability and high genetic advance for plant height followed by biological yield per plant and silliqua on main raceme was earlier reported by Singh et. al. (2011) [18] which indicated that improvement in this trait could be done through selection for breeding programme. High heritability with high genetic advance as percent of mean was observed for biological yield per plant (96% and 46.89) followed by silliqua on main raceme (95% and 38.82), grain yield per plant (62 % and 35.40) and fruiting branching (84% and 17.65) as reported by Mahla *et. al*. (2003) [11], Tiwari *et. al*. (2017) [4], Sharma *et.al.* (2014) [14] and Mondal and Khajuria, (2000) [12]. The genotypic simple correlation among all the characters have been presented in Table-3 the estimates of highly positive significant correlation with yield for five characters viz. days to 50 %flowering (0.4791), plant height (0.5409), fruiting branch length (0.6297), silliqua on main raceme (0.8061) and biological yield per plant (0.8822) and two characters were found negative and significance correlation with yield viz. secondary branches per plant (-0.6455) and silliqua length (-0.3839). These characters were indicating their true relationship with yield. Similar findings have been given by the following authors Singh *et. al.* (2011) [18], Yadav *et al* (2011) [19], Singh and Singh (2010) [17], Shweta and Om Prakash (2014) [15], Shanlni *et al.* (2000) and Tiwari *et al.* (2017) [4].

The estimates of direct and indirect effects of different character on grain yield per plant are presented in table -4. The path coefficient analysis revealed that yield contributing traits like days to 50% flowering (0.7564), silliqua on main raceme (0.6374) and biological yield per plant (0.3797) had highest direct positive effect on seed yield per plant also exhibited high degree of positive significant correlation with yield. The indirect effects via any other traits were found lesser than the direct effect. However the highest indirect effect of these traits was exhibited through biological yield (0.6104) and days to 50% flowering (0.5082) showed direct positive effect on seed yield per plant. Positive direct effects of these traits on grain yield indicated their importance in determining this complex character and therefore should be kept in mind while practicing selection aimed at the improvement of seed yield. The indirect effects of these characters were found lesser than the magnitudes of this direct effect on yield which indicated that these characters were affecting the grain yield directly. Similar result also reported by Shanlni *et. al.* (2000), Singh and Singh (2010) [17], Mahla *et al*. (2003) [11], and Kumar *et.al.* (2016) [10].

Table 1: ANOVA for different characters in the present investigation.

S. No.	Characters	Mean sum of squares		F Value
		Replication (d.f.=2)	Treatments (d.f.=11)	
1.	Days to 50% Flowering	0.2205	2.0278	3.8594**
2.	Plant Height (cm)	4.5270	430.6728	98.3277**
3.	Primary branches/ plant	0.1717	0.9608	3.5329**
4.	Secondary branches/ plant	0.3472	0.2342	2.3885*
5.	Fruiting Branch length (cm)	2.0608	67.7451	17.2277**
6.	Silliqua on main raceme	4.8203	97.3445	62.4620**
7.	Silliqua length(cm)	0.1575	0.7346	3.1372*
8.	Days to maturity	0.6580	2.8763	3.8799**
9.	Biological Yield/ Plant (g)	6.8678	260.3917	66.5981**
10.	No.of seed per siliqua	0.9003	12.1276	9.0588**
11.	1000 Seed Weight (g)	0.4115	0.3333	2.6566*
12	Harvest Index (%)	0.7892	18.9800	5.0430**
13	Grain Yield/ Plant (g)	0.0669	6.9475	5.9598**

**significant at 5% level of significance

Table 2: Estimates of GCV, PCV, Heritability, Genetic Advance & Genetic Advance as percent of mean.

S. No.	Characters	GCV	PCV	H^2 (bs) %	GA 5%	GA as % OF Mean 5%
1	Days to 50% Flowering	1.22	1.75	0.49	1.02	1.76
2	Plant Height (cm)	6.27	6.36	0.97	24.19	12.72
3	Primary branches/ plant	10.01	14.79	0.46	0.67	13.95
4	Secondary branches/ plant	8.00	14.22	0.32	0.25	9.27
5	Fruiting Branch length (cm)	9.33	10.15	0.84	8.73	17.65
6	Silliqua on main raceme	19.30	19.76	0.95	11.37	38.82
7	Silliqua length(cm)	7.89	12.24	0.42	0.54	10.49
8	Days to maturity	0.88	1.26	0.49	1.22	1.27

9	Biological Yield/ Plant (g)	23.28	23.80	0.96	18.63	46.89
10	No.of seed per siliqua	14.97	17.53	0.73	3.33	26.32
11	1000 Seed Weight (g)	3.67	6.16	0.36	0.32	4.51
12	Harvest Index (%)	13.80	18.21	0.57	3.52	21.54
13	Grain Yield/ Plant (g)	21.77	27.58	0.62	2.26	35.40

Table 3: Estimation of genotypic correlation coefficient for among different quantitative characters and seed yield.

S. No.	Characters	Days to 50% Flowering	Plant Height (cm)	Primary branches/ plant	Secondary branches/ plant	Fruiting Branch length (cm)	Silliqua on main raceme	Silliqua length(cm)	Days to maturity	Biological Yield/ Plant (g)	No.of seed per silliqua	1000 Seed Weight (g)	Harvest Index (%)	"r" with yield (g)
1	Days to 50% Flowering	1.0000	0.3333	-0.0688	0.4214*	0.6034*	0.7973*	-0.6768*	0.3660*	0.8070*	-0.1321	-0.4097*	-0.6615*	0.4791*
2	Plant Height (cm)		1.0000	0.4106*	0.0414*	0.3559*	0.4503*	-0.2768	-0.0230	0.5106*	0.1094	-0.4528*	-0.2502	0.5409*
3	Primary branches/ plant			1.0000	0.3005	-0.1151	-0.0374	-0.1587	0.1963	0.0033	-0.4947*	-0.2714	-0.5366*	-0.2756
4	Secondary branches/ plant				1.0000	-0.0552	-0.2860	0.2616	0.6031*	-0.0780	-0.3971*	0.0856	-0.9717*	-0.6455*
5	Fruiting Branch length (cm)					1.0000	0.7017*	-0.3392	0.0015	0.4057*	-0.0178	-0.1040	0.2392	0.6297*
6	Silliqua on main raceme						1.0000	-0.6819*	0.1913	0.7251*	-0.3523*	-0.2111	-0.0238	0.8061*
7	Silliqua length(cm)							1.0000	0.3630*	-0.4592*	0.6590*	0.4765*	0.2682	-0.3839*
8	Days to maturity								1.0000	0.1228	0.1196	-0.2939	-0.1011	0.1058
9	Biological Yield/ Plant (g)									1.0000	-0.0287	-0.3402*	-0.4710*	0.8822*
10	No.of seed per siliqua										1.0000	-0.3802*	0.3944*	0.2796
11	1000 Seed Weight (g)											1.0000	0.3225	-0.2689
12	Harvest Index (%)												1.0000	0.0117

*significant at 5% level of significance.

Table 4: Direct and indirect effect of yield components on seed yield (genotypic)

S. No.	Characters	Days to 50% Flowering	Plant Height (cm)	Primary branches/ plant	Secondary branches/ plant	Fruiting Branch length (cm)	Silliqua on main raceme	Silliqua length(cm)	Days to maturity	Biological Yield/ Plant (g)	No.of seed per silliqua	1000 Seed Weight (g)	Harvest Index (%)	Grain Yield/ Plant (g)
1	Days to 50% Flowering	0.7564	0.2521	-0.0521	0.3187	0.4564	0.6031	-0.5119	0.2769	0.6104	-0.0999	-0.3099	-0.5004	0.4791*
2	Plant Height (cm)	-0.0231	-0.0694	-0.0285	-0.0029	-0.0247	-0.0312	0.0192	0.0016	-0.0354	-0.0076	0.0314	0.0174	0.5409*
3	Primary branches/ plant	-0.0357	0.2126	0.5179	0.1556	-0.0596	-0.0194	-0.0822	0.1017	0.0017	-0.2562	-0.1406	-0.2779	-0.2756
4	Secondary branches/ plant	-0.1291	-0.0127	-0.0921	-0.3065	0.0169	0.0877	-0.0802	-0.1848	0.0239	0.1217	-0.0262	0.2978	-0.6455*
5	Fruiting Branch length (cm)	-0.1723	-0.1016	0.0329	0.0158	-0.2855	-0.2003	0.0969	-0.0004	-0.1158	0.0051	0.0297	-0.0683	0.6297*
6	Silliqua on main raceme	0.5082	0.2870	-0.0238	-0.1823	0.4472	0.6374	-0.4346	0.1219	0.4621	-0.2246	-0.1346	-0.0152	0.8061*
7	Silliqua length(cm)	-0.2216	-0.0906	-0.0520	0.0857	-0.1111	-0.2233	0.3275	0.1189	-0.1504	0.2158	0.1561	0.0878	-0.3839*
8	Days to maturity	-0.1219	0.0077	-0.0654	-0.2008	-0.0005	-0.0637	-0.1208	-0.3329	-0.0409	-0.0398	0.0978	0.0336	0.1058
9	Biological Yield/ Plant (g)	0.3064	0.1939	0.0012	-0.0296	0.1541	0.2753	-0.1744	0.0466	0.3797	-0.0109	-0.1292	-0.1788	0.8822*
10	No.of seed per siliqua	-0.0734	0.0607	-0.2747	-0.2205	-0.0099	-0.1956	0.3659	0.0664	-0.0159	0.5553	-0.2111	0.2190	0.2796
11	1000 Seed Weight (g)	-0.1096	-0.1212	-0.0726	0.0229	-0.0278	-0.0565	0.1275	-0.0786	-0.0910	-0.1017	0.2676	0.0863	-0.2689
12	Harvest Index (%)	-0.2053	-0.0777	-0.1665	-0.3016	0.0742	-0.0074	0.0832	-0.0314	-0.1462	0.1224	0.1001	0.3104	0.0117

Acknowledgement
The author is very much thanks full and highly obliged to Prof. Surendra Dubey; Vice Chancellor and Prof. K. R. Maurya, Director, Bundelkhand University Jhansi for providing necessary facilities and encouragement due to which this research project was completed.

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