Phytology

Path coefficient analysis in mustard (*Brassica juncea* L.)

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Abstract
An field experiment was conducted with 20 genotypes of Indian Mustard (*Brassica juncea* L.) at the farm of Agricultural Research Sub Station, Sumerpur with an objective to find out path coefficient analysis and came to a conclusion that research showed positive direct effect with characters like days to 50% flowering, number of silique per plant, number of seeds per silique, 1000 seed weight, biological yield wherein seed yield per plant showed highest values thereafter maximum negative direct effect showed by length of main raceme for genotypic characters. While for phenotypic positive direct effect were expressed for characters like days to 50% flowering, number of primary branches per plant, days to maturity, number of siliquae per plant, number of seeds per silique, 1000 seed weight, biological yield per plant where negative direct effect was exhibited by number of secondary branches per plant, length of main raceme, plant height.

Keywords: Indian mustard, path coefficient analysis, genotypic, phenotypic

Introduction

Indian Mustard (*Brassica juncea* L.) also known as Rai and Raya in rural regions is one of the vastly cultivated oilseeds in India falls next to groundnut in oilseed production. Indian Mustard belongs to the family *Brassicaceae* and genus *Brassica*. Developed as the result of interspecific natural hybridization between (*Brassica nigra*) and (*Brassica campestris*). It is a highly self-pollinated crop. Cytologically, mustard is an amphidiploid species with a chromosome number of 2n=36 (Shekhawat *et al.* 2012) [2]. Mustard also has an available genetic diversity as in form of 310 genera and 3500 species (Thomas *et al.* 2012) [3]. In India, the total area under Rapeseed – Mustard is about 68.56 lakh ha with a production of 91.23 lakh tonnes. However, average yield per hectare is 1331 kg ha-1. In Madhya Pradesh, it is grown in an area of 6.75 lakh ha with a total production of 10.38 lakh tonnes. However, productivity is 15.38 kg ha-1 (Directorate of Economics and Statistics, 2019-20). It is India's second most important oilseed crop, next only to soybean. All India coordinated research program on oilseed was established on 1967 in Bharatpur, Rajasthan. Path Analysis was firstly introduced by Sewell Wright in the year 1921 and defined it as ratio of standard deviation due to a given cause to the total standard deviation of the effect. Path analysis as in the form of statistical approach represent the estimates of contribution by examining the associations between a dependent variable and two or more independent variables.

Materials and methods

Twenty genotypes were studied in three replication and evaluated using Randomised Block Design at the farm of Agricultural Research Sub Station, Sumerpur in the year 2017-18 during Rabi season. Row-to-plant spacing of 45×15 cm was maintained and proper plant population was maintained by thinning. The recommended agricultural package of practices was followed. Observation was recorded for various yield traits on five randomly selected plants in every genotype from each replication.

Genotypes Studied – PM 25, Sej- 2, Shraddha, JM 3, Krishna, Pusa Jaikishan, Rohini, Maya, Kranti, PM 26, NRCDR 2, Vasundhara, RVM 3, Varuna, Pusa Jagannath, RVM 2, Giriraj, Pusa Vijay, RH 725 and Swarnjyoti all the genotypes were sourced from AICRP, Bharatpur and ZARS, Morena.

Results and discussion

The path coefficient technique given by Wright (1921) [4] has been used to evaluate the magnitude and direction of direct and indirect effects of various yields and their contributing characters. If the correlation between yield and a character is due to direct the effect of a character, it reveals the true relationship between them, and direct selection for this trait will be rewarding for yield improvement. The present results of phenotypic and genotypic path coefficient of yield and yield contributing characters discussed here under which were presented in (Table 2 and 3). Path coefficient analysis for genotypic coefficient analysis revealed that harvest index had the maximum positive direct effect (0.6606) on seed yield per plant followed by biological yield (0.2542) at the genotypic level. Days to maturity (0.1508), number of primary branches per plant (0.1123), number of silique per plant (0.1624), days to 50% flowering (0.0159), number of seeds per silique (0.1658), 1000 seed weight (0.1358) showed a positive direct effect on seed yield while, number of secondary branches per plant (-0.0903), length of main raceme (- 0.3925), plant height (-0.0253) showed a negative direct effect on seeds yield per plant. Maximum negative direct effect recorded in case of length of main raceme (-0.3925). The estimates of residual effect were (0.3501).

Phenotypic coefficient analysis under normal conditions showed that harvest index had the maximum positive direct effect (0.6697) on seed yield followed by biological yield per plant (0.2584) at phenotypic level. Number of primary branches per plant (0.1150), days to 50% flowering (0.0163), number of siliquae per plant (0.1575), days to maturity (0.1519), number of seeds per silique (0.1607), 1000 seed weight (0.1311) exhibited positive direct effect while, number of secondary branches per plant (-0.0911), length of main raceme (-0.3925), plant height (-0.0288) showed negative direct effect on seed yield. Maximum negative direct effect recorded in case of length if main raceme (-0.3925). The estimates of residual effect were (0.3533).

Table 1: Mean value of 20 genotypes for 12 quantitative characters in mustard

Traits	Primary Branches/ plant	Secondary Branches/ plant	Days to 50% flowering	Length of Main Raceme	Plant Height	No. of Siliquae/ plant	Days to Maturity	No. of Seed/Siliquae	1000 Seed Weight	Biological Yield	Harvest Index	Seed Yield/ Plant
PM 25	9.73	18.67	44.57	79.93	161.33	86.61	120.72	11.62	4.07	143.26	20.83	29.85
Sej 2	8.67	18.33	50.60	82.00	171.60	85.48	126.31	12.49	4.25	154.58	19.75	30.54
Shraddha	10.20	25.80	51.07	70.53	176.80	92.22	118.41	9.31	4.25	116.26	31.03	36.08
JM3	9.13	22.87	51.23	78.67	188.20	102.78	112.35	7.53	3.78	101.37	26.84	27.24
Krishna	9.07	23.13	47.53	92.40	174.00	71.60	121.09	9.39	3.95	159.49	11.58	18.48
Pusa Jaikishan	9.47	20.67	53.07	56.07	160.73	87.66	114.65	11.53	4.13	107.60	16.99	33.87
Rohini	10.07	20.53	53.67	66.73	199.33	82.73	114.66	8.62	4.30	116.61	25.35	29.56
Maya	9.20	20.77	49.97	72.93	177.40	76.65	118.56	12.55	4.94	104.59	30.64	32.05
Kranti	9.07	16.20	54.23	66.13	160.20	95.44	119.64	10.83	4.36	113.24	29.35	33.25
PM26	9.67	18.40	43.70	80.73	161.33	101.69	121.51	11.56	4.16	146.43	22.38	32.77
NRCDR 2	9.00	20.00	35.60	65.87	145.47	77.65	122.10	12.45	4.90	149.26	21.42	31.98
Vasundhara	7.67	18.20	47.47	74.00	154.47	65.50	123.42	12.56	4.41	154.40	21.53	33.25
RVM 3	8.27	18.33	48.70	80.20	183.07	76.61	118.38	8.08	3.68	149.50	16.29	24.36
Varuna	8.67	17.27	39.53	87.47	133.07	79.43	122.07	8.60	4.55	195.27	14.35	28.04
Pusa Jagannath	9.33	24.17	42.47	80.73	154.20	77.54	123.47	12.85	4.36	104.30	31.90	33.27
RVM 2	8.27	20.13	43.73	92.27	204.60	78.41	126.77	8.43	3.55	113.57	19.60	22.27
Giriraj	8.47	23.20	51.40	57.20	145.33	86.40	115.01	11.48	3.43	162.29	16.79	27.26
Pusa Vijay	10.87	26.03	48.40	94.00	210.60	115.12	116.51	13.57	5.27	199.22	39.30	42.29
RH 725	9.93	18.60	44.43	79.00	195.40	75.04	116.58	13.48	4.04	104.54	33.30	34.81
Swarnjyoti	10.00	20.20	44.00	77.00	160.80	84.53	117.45	12.53	4.16	134.16	20.94	28.10

Table 2: Genotypic path matrix of seed yield per plant of 20 genotypes for 12 quantitative characters

Traits	Primary branches/plant	Secondary branches/ plant	Days to 50% flowering	Length of main raceme	Plant height	No. of silique per plant	Days to maturity	No. of seed/silique	1000 seed weight	Biological yield	Harvest index	Seed yield/ plant
Primary branches/plant	0.112	0.050	0.010	0.006	0.043	0.066	-0.052	0.030	0.045	-0.010	0.068	0.542
Secondary branches/plant	-0.041	-0.090	-0.015	-0.007	-0.028	-0.030	0.030	-0.002	-0.009	0.001	-0.034	0.189
Days to 50% flowering	0.001	0.003	0.016	-0.006	0.006	0.005	-0.008	-0.003	-0.003	-0.005	0.002	0.084
Length of main raceme	-0.020	-0.031	0.148	-0.393	-0.150	-0.020	-0.175	0.047	-0.033	-0.146	-0.019	-0.217
Plant Height	-0.010	-0.008	-0.009	-0.010	-0.025	-0.007	0.006	0.004	0.001	0.006	-0.012	0.0657
No. of silique per plant	0.095	0.054	0.048	0.008	0.045	0.162	-0.065	0.001	0.031	0.021	0.073	0.470
Days to maturity	-0.070	-0.050	-0.075	0.067	-0.035	-0.060	0.151	0.020	0.012	0.032	-0.036	-0.187
No. of seed/silique	0.044	0.003	-0.034	-0.020	-0.029	0.001	0.022	0.166	0.083	0.015	0.068	0.623
1000 seed weight	0.054	0.014	-0.029	0.011	-0.005	0.026	0.011	0.068	0.136	0.036	0.070	0.067
Biological Yield	-0.023	-0.002	-0.075	0.094	-0.062	0.033	0.053	0.023	0.068	0.254	-0.076	0.007
Harvest Index	0.398	0.246	0.098	0.032	0.306	0.296	-0.158	0.270	0.339	-0.198	0.661	0.764

Rsquare=0.8775, Residual effect = 0.3501

Table 3: Phenotypic path matrix of seed yield per plant of 20 genotypes for 12 quantitative characters

Traits	Primary Branches/ plant	Secondary Branches/ plant	Days to 50% flowering	Length of main raceme	Plant height	No. of Silique per plant	Days to maturity	No. of seed/silique	1000 seed weight	Biological yield	Harvest index	Seed yield/plant
Primary branches/plant	0.115	0.051	0.010	0.006	0.044	0.067	-0.053	0.030	0.046	-0.011	0.069	0.540
Secondary branches/plant	-0.041	-0.091	-0.015	-0.007	-0.028	-0.030	0.030	-0.002	-0.009	0.001	-0.034	0.189
Days to 50% flowering	0.001	0.003	0.016	-0.006	0.006	0.005	-0.008	-0.003	-0.003	-0.005	0.002	0.083
Length of main raceme	-0.020	-0.031	0.148	-0.393	-0.150	-0.020	-0.175	0.047	-0.033	-0.146	-0.019	-0.216

Plant Height	-0.011	-0.009	-0.010	-0.011	-0.029	-0.008	0.007	0.005	0.001	0.007	-0.013	0.066
No. of silique per plant	0.092	0.052	0.046	0.008	0.044	0.158	-0.063	0.001	0.030	0.020	0.071	0.469
Days to maturity	-0.070	-0.050	-0.075	0.068	-0.035	-0.061	0.152	0.020	0.012	0.032	-0.036	-0.186
No. of seed/siliquae	0.042	0.003	-0.033	-0.019	-0.028	0.001	0.021	0.161	0.080	0.015	0.065	0.620
1000 seed weight	0.052	0.013	-0.028	0.011	-0.005	0.025	0.010	0.066	0.131	0.035	0.067	0.067
Biological yield	-0.024	-0.002	-0.076	0.096	-0.063	0.033	0.054	0.023	0.069	0.258	-0.077	0.007
Harvest index	0.402	0.249	0.099	0.032	0.310	0.300	-0.160	0.273	0.343	-0.200	0.670	0.764

Rsquare=0.8752, Residual effect = 0.3533

Summary and conclusion

Research conducted on Agricultural Research Sub Station, Sumerpur during Rabi season in 2017-18 in which the results displayed that path coefficient analysis exhibit maximum direct effects values for characters like harvest index (0.6606) (0.6697), biological yield (0.2542) (0.2584) on seed yield both at the genotypic and phenotypic levels, respectively.

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