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Correlation and path coefficient analysis for seed yield and its contributing traits in Indian mustard (*Brassica juncea* L. Czern & Coss)

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Abstract
Forty five genotypes of Indian mustard were used in a 3-replication Randomised Block design (RBD) experiment to take a look at correlation and direction evaluation for 12 quantitative parameters. Three randomly selected flora from each genotype in each replication have been examined for grain yield consistent with plant, take a look at weight, oil content, days to 50% flowering, days to seed filling, days to adulthood, length of predominant shoot, number of pods on most important shoot, variety of number one branches, range of secondary branches, plant top, and number of seeds pod^{-1}. For every of the investigated trends, every genotype showed a highly sizable distinction. range of number one branch and quantity of secondary branch matter all showed high genotypic and phenotypic coefficients of variant (GCV and PCV) in Grain yield, The genotypic correlation coefficient values have been usually better than the phenotypic correlation coefficient values. At each the genotypic and phenotypic stages, grain yield plant^{-1} had a incredibly substantial positive correlation with (0.627), number of secondary branches consistent with plant (zero.558), length of predominant shoot (zero.556), wide variety of pods on main shoot (0.500), wide variety of number one branches according to plant (zero.443) and days to 50% flowering (0.224). Indicating that the environment had little influence on the affiliation. As a result, enhancing those characteristics can bring about expanded grain output plant^{-1}. Plant height, range of secondary branches plant^{-1}, and quantity of seeds pod^{-1} all established a strong high quality direct impact at both the genotypic and phenotypic tiers some of the numerous attributes evaluated. This validated that these trends are the most critical in determining grain output plant^{-1}, and they may be effortlessly superior through choice.

Keywords: Correlation, route coefficient, GCV, PCV and Indian mustard

1. Introduction
The cruciferae circle of relatives includes Indian mustard (*Brassica juncea*). Rai is the famous name for Indian mustard. *Brassica juncea* is an amphidiploid (2n = 36) on account of a hybrid among Brassica nigra (2n = 16) and Brassica campestris (2n = 20). Brassica genus has various economically important vegetation that produce fit for human consumption oil, roots, stems, leaves, buds, vegetation, and seeds. India's major rabi oilseed crop is mustard. Indian mustard [*Brassica juncea* (L.) Czern and Coss.] is the most critical economically important oilseed crop in India, accounting for around eighty% of total rapeseed-mustard acreage. After China, India is the world's 2nd-largest rapeseed-mustard producer, with a 20.23% land area and an 11.7% share of global manufacturing. Kumar and Pandey (2014) [8] Rapeseed - mustard ranks 2nd most of the 7 suitable for eating oilseeds produced in India, accounting for 28.6% of overall oilseed manufacturing, in the back of groundnut, which money owed for 27. Eight% of the Indian oilseed economy. For maximum seed and oil development, the crop requires a more temperature to finish the vegetative phase and a groovy temperature and clear sky all through the reproductive section. Frost and overcast weather throughout flowering is specially destructive; pest and disease occurrence is better in such situations, leading in reduced seed output. Mustard is a plant with a short developing season. Indians, West Asians (Indian subcontinent), and chinese have known the oil derived from mustard seeds for its culinary fat for over 3000 years. Because it's miles high in unsaturated fatty acids and coffee in saturated fatty acids, mustard-rapeseed oil is now nutritionally superior to other oilseeds, specially after the advent of 'canola' pleasant mustard-rapeseed in North the us, the european Union, and Australia. Some of variables are investigated in correlation, providing perception into indirect selection.

In any crop species, oblique selection is similarly large in shaping the very last end result, grain yield. Course coefficient evaluation has emerge as a enormously powerful device because it determines the direct and oblique motives of association, offering the idea of distinct forces that act to produce sturdy correlation, and it also quantifies the relative importance of each causal element.

2. Materials and Methods

The substances for the existing research consisted of forty five numerous lines of Indian Mustard (*Brassica juncea* L. Czern and Coss, 2n = 36) which have been collected from the branch of Genetics and Plant Breeding, Chandra Shekhar Azad university of Agriculture and technology, Kanpur, IARI, New Delhi and CCSHAU, Hisar. Some of them had been launched sorts for distinct zones and other promising lines which have been earlier degree of testing in All India coordinated or nation varietal trials. All of the 45 genotypes had been grown in Randomized Block design (RBD) with three replications. The period of the rows changed into stored four.0 m and spacing between row to row 30 cm and plant to plant10 cm. Three aggressive flora had been randomly decided on from each entry in each replication and have been tagged for recording designated field and laboratory observations later on the information on yield and yield components have been recorded on those randomly decided on vegetation besides days to 50% flowering and days to maturity which have been recorded on the plot foundation. The experimental data had been subjected to statistical evaluation as following general statistical method described Panse and Sukhatme (1969) [10] to assess thing of variance and coefficient of version. Allard (1960) [2] to assess component of Heritability and Johnson *et al*. (1955) [7] to assess component of genetic boost.

3. Results and Discussion

By means of assessing the degree of affiliation between two characters, the correlation establishes how they differ or if there's any courting between them. Yield is a complicated trait that is substantially impacted by environmental modifications and is in most cases managed through a massive variety of genes. Knowing their correlation will allow you to gauge how intently yield and the contributing factors are associated. In this paintings, the genotypic and phenotypic correlation coefficients among grain yield and its constituent attributes had been computed. In popular, the levels of the genotypic and phenotypic correlation coefficients had been decrease. This proved that phenotypic level environmental impacts were concealing great intrinsic linkages. Grain yield plant^{-1} become determined to be noticeably appreciably undoubtedly correlated with plant peak (0.596), number of seeds consistent with pod (0.403), duration of primary shoot (zero.166), variety of number one branches plant^{-1}, and days to 50% flowering at each the genotypic and phenotypic tiers. This finding suggests that environmental factors may additionally play a role in association. Enhancing those attributes can consequently cause a plant's grain output increasing.1. Pandey *et al*. (2019) [9] and Yadav *et al*. (2020) [13] all stated comparable findings. Poor and non-sizable affiliation became confirmed for grain yield plant^{-1} with oil content material and range of seed pod^{-1}. Comparable file, has come Pandey *et al*. (2019) [9]. Subsequently, on the premise of correlation coefficient research, it's far located, that the characters viz., plant peak, number of secondary branches plant^{-1}, period of principal shoot, wide variety of pods on principal shoot , variety of primary branches plant^{-1} and days to 50% flowering have been undoubtedly correlated with grain yield plant^{-1} and additionally among themselves indicating their application in choice programme for enhancing yield capability of populace. The modification of plant structure has played an vital role in growing greater green genotype owning expanded yield capacity. Considering that grain yield is a complicated character governed by using polygenes, its development is largely related with deep expertise of inter-relationships among additives affecting. The correlation coefficient indicated the relationship current between pair of characters. However a based person was an interaction of fabricated from many at the same time associated element characters and alternate in anybody aspect will disturb complete network of purpose and effect system. The path coefficient evaluation, a statistical tool developed by using Wright (1921) [14], which takes into account the motive and impact dating among the variables which is particular in partitioning the affiliation into direct and indirect consequences thru other dependent variables. The route coefficient analysis also measures the relative significance of causal factors concerned. This is simply standardized regression analysis; in which in overall correlation price is sub-divided into causal scheme. The route analysis advised through Dewey and Lu (1959) [4] helps to solve these correlations further and throws greater mild on the way in which component developments contribute closer to specially figuring out important component tendencies. Within the present investigation grain yield plant^{-1} was established variable and rest of the nine characters had been impartial variables. (table three and four) a few of the numerous developments studied, plant top, number of secondary branches plant^{-1} and variety of seeds pod^{-1} had excessive high-quality direct effect at both genotypic and phenotypic ranges. This indicated that plant peak, wide variety of secondary branches plant^{-1} and number of seeds pod^{-1} are maximum important characters in influencing grain yield plant^{-1}. Grain yield plant^{-1} could be progressed with the aid of selection based totally on these characters. The direct outcomes of ultimate characters on grain yield plant^{-1} were of low in importance. These effects are in popular agreement with the finding of Roy *et al*. (2015) [11], Jat *et al* (2019) [6] Roy *et al*. (2017) [12], Bind *et al*. (2013) [3]. Plant top confirmed excessive nice indirect impact on grain yield plant^{-1} via, duration of predominant shoot, wide variety of pods on important shoot, number of number one branches plant^{-1}, number of secondary branches plant^{-1}, days to maturity and days to 50% flowering at each genotypic and phenotypic level. Range of secondary branches plant^{-1} exhibited high positive indirect contribution on grain yield plant^{-1} via, plant top, variety of number one branches plant^{-1}, quantity of pods on predominant shoot and length of main shoot. Comparable end result became also supported by means of the findings of Pandey *et al*. (2019) [9], Dond *et al*. (2012) [5] and Afrin *et al*. (2011) [1]. In the gift observe on the premise of direction analysis it become identified that plant top, wide variety of secondary branches plant^{-1} and range of seeds pod^{-1} are as vital direct yield contributing characters, those characters have been additionally discovered to be beneficial for indirect participants via each different. Plant height, number of secondary branches plant^{-1} appeared as maximum critical indirect yield additives. The characters stated above, merit due consideration at the time of making plans choice approach aimed with growing high yielding promising traces in Brassica. The contribution of residual outcomes that inspired grain yield plant^{-1} was very low at each genotypic and phenotypic ranges indicating that the characters blanketed inside the present investigation have been sufficient enough to account for the variability within the established person.

Table 1: Genotypic correlation coefficient among twelve characters in Indian mustard (*Brassica juncea* L.)

Characters	Days to 50% flowering	Seed feeling period	Days to Maturity	Plant Height (cm)	Number of Primary Branches	Number of Secondary Branches	Number of Pods on Main Shoot	Length of Main Shoot	Test weight (g)	Number of Seed per pod	Oil Content (%)	Seed yield/ per plant
Days to 50% flowering	1.000	-0.803**	0.822**	0.412**	0.269**	0.306**	0.261**	0.295**	0.389**	-0.213*	0.027	0.224**
seed feeling period			-0.275**	-0.238**	-0.106	-0.097	-0.154	-0.203*	-0.363**	0.116	-0.061	-0.234**
Days to Maturity				0.398**	0.295**	0.325**	0.253**	0.246**	0.215*	-0.195*	0.066	0.133
Plant Height (cm)					0.647**	0.731**	0.804**	0.857**	0.110	-0.266**	-0.095	0.627**
Number of primary Branches						0.555**	0.621**	0.575**	0.043	0.258**	-0.218*	0.443**
Number of secondary Branches							0.576**	0.642**	0.208*	-0.480**	-0.343**	0.558**
Number of pods on Main Shoot								0.843**	-0.110	-0.070	-0.179*	0.500**
Length of Main Shoot									0.091	-0.240**	-0.030	0.556**
Test weight (g)										-0.218*	-0.233**	0.132
Number of seed per pod											0.109	-0.081
Oil Content (%)												-0.187*
Seed yield /plant (g)												1.000
*, ** significant at 5% and 1% level, respectively												

Table 2: Phenotypic correlation coefficient among twelve characters in Indian Mustard (*Brassica juncea* L.)

Characters	Days to 50% flowering	Seed feeling period	Days to Maturity	Plant Height (cm)	Number of Primary Branches	Number of Secondary Branches	Number of Pods on Main Shoot	Length of Main Shoot	Test weight (g)	Number of Seed per pod	Oil Content (%)	Seed yield/ per plant
Days to 50% flowering	1.000	-0.700**	0.754**	0.364**	0.273**	0.288**	0.247**	0.254**	0.379**	-0.181*	-0.013	0.202*
seed feeling period			-0.214*	-0.202*	-0.106	-0.087	-0.140	-0.178*	-0.326**	0.102	-0.044	-0.210*
Days to Maturity				0.364**	0.277**	0.298**	0.231**	0.230**	0.194*	-0.185*	0.021	0.124
Plant Height (cm)					0.592**	0.713**	0.744**	0.834**	0.098	-0.255**	-0.050	0.602**
Number of primary Branches						0.523**	0.605**	0.515**	0.068	0.238**	-0.160	0.427**
Number of secondary Branches							0.538**	0.631**	0.180*	-0.450**	-0.236**	0.548**
Number of pods on Main Shoot								0.767**	-0.086	-0.084	-0.151	0.487**
Length of Main Shoot									0.051	-0.216*	-0.004	0.539**
Test weight (g)										-0.238**	-0.165	0.113
Number of seed per pod											0.055	-0.075
Oil Content (%)												-0.135
Seed yield /plant (g)												1.000
*, ** significant at 5% and 1% level, respectively												

Table 3: Genotypic path coefficient analysis for twelve characters in Indian Mustard (*Brassica juncea* L.)

Characters	Days to 50% flowering	Seed feeling period	Days to Maturity	Plant Height (cm)	Number of Primary Branches	Number of Secondary Branches	Number of Pods on Main Shoot	Length of Main Shoot	Test weight (g)	Number of Seed per pod	Oil Content (%)	R with Seed yield/per plant
Days to 50% flowering	0.660	-0.194	-0.447	0.246	-0.076	0.139	-0.051	0.049	-0.014	-0.086	-0.002	0.224**
seed feeling	-0.530	0.241	0.149	-0.142	0.030	-0.044	0.030	-0.034	0.013	0.047	0.005	-0.234**
Days to Maturity	0.542	-0.066	-0.544	0.237	-0.083	0.148	-0.049	0.041	-0.008	-0.079	-0.006	0.133
Plant Height (cm)	0.272	-0.057	-0.216	0.596	-0.183	0.333	-0.157	0.143	-0.004	-0.107	0.008	0.627**
Primary Branches	0.177	-0.026	-0.160	0.386	-0.283	0.253	-0.121	0.096	-0.002	0.104	0.019	0.443**
Secondary Branches	0.202	-0.023	-0.177	0.436	-0.157	0.455	-0.112	0.107	-0.008	-0.193	0.029	0.558**
Pods on Main Shoot	0.172	-0.037	-0.138	0.479	-0.176	0.262	-0.195	0.140	0.004	-0.028	0.015	0.500**
Length of Main Shoot	0.194	-0.049	-0.134	0.511	-0.163	0.292	-0.164	0.166	-0.003	-0.097	0.003	0.556**
Test weight (g)	0.256	-0.088	-0.117	0.066	-0.012	0.095	0.021	0.015	-0.036	-0.088	0.020	0.132
Number of Seed per pod	-0.140	0.028	0.106	-0.159	-0.073	-0.218	0.014	-0.040	0.008	0.403	-0.009	-0.081
Oil Content (%)	0.018	-0.015	-0.036	-0.056	0.062	-0.156	0.035	-0.005	0.008	0.044	-0.085	-0.187*
Resi = 0.0504												
*, ** significant at 5% and 1% level, respectively												

Table 4: Phenotypic path coefficient analysis for twelve characters in Indian mustard (*Brassica juncea* L.)

Characters	Days to 50% flowering	Seed feeling period	Days to Maturity	Plant Height (cm)	Number of Primary Branches	Number of Secondary Branches	Number of Pods on Main Shoot	Length of Main Shoot	Test weight (g)	Number of Seed per pod	Oil Content (%)	R with Seed yield/per plant
Days to 50% flowering	-0.200	0.169	0.005	0.141	-0.029	0.116	0.014	0.008	0.023	-0.045	0.001	0.202*
Seed feeling periods	0.140	-0.241	-0.001	-0.078	0.011	-0.035	-0.008	-0.005	-0.020	0.025	0.002	-0.210*
Days to Maturity	-0.151	0.052	0.007	0.141	-0.030	0.120	0.013	0.007	0.012	-0.046	-0.001	0.124
Plant Height (cm)	-0.073	0.049	0.002	0.387	-0.064	0.288	0.043	0.025	0.006	-0.063	0.002	0.602**
Number of Primary Branches	-0.055	0.026	0.002	0.229	-0.108	0.211	0.035	0.016	0.004	0.059	0.007	0.427**
Number of Secondary Branches	-0.058	0.021	0.002	0.276	-0.056	0.404	0.031	0.019	0.011	-0.112	0.011	0.548**
Pods on Main Shoot	-0.049	0.034	0.002	0.288	-0.065	0.217	0.058	0.023	-0.005	-0.021	0.007	0.487**
Length of Main Shoot	-0.051	0.043	0.002	0.323	-0.056	0.255	0.044	0.030	0.003	-0.054	0.000	0.539**
Test weight (g)	-0.076	0.079	0.001	0.038	-0.007	0.073	-0.005	0.002	0.061	-0.059	0.008	0.113
Number of Seed per pod	0.036	-0.025	-0.001	-0.099	-0.026	-0.182	-0.005	-0.007	-0.015	0.249	-0.003	-0.075
Oil Content (%)	0.003	0.011	0.000	-0.019	0.017	-0.095	-0.009	0.000	-0.010	0.014	-0.046	-0.135

Resi = 0.0540

*, ** significant at 5% and 1% level, respectively

4. Conclusion

Variance analysis demonstrated that the current set of breeding material had considerable genetic variance, and research into genetic factors using these genotypes worth valuable results. The current research into correlation coefficient and path analysis, suggested that these traits could be used directly to improve grain yield per plant, as they showed a highly significant and positive relationship with the characters of plant height, number of primary branches per plant, and test weight.

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