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Correlation and path analysis of different environments for yield and component traits in groundnut (*Arachis hypogaea* L.)

Preeti Pachauri and R. S. Sikarwar

Abstract
In a breeding program, studies of genotypic and phenotypic relationships among agricultural crop traits are useful to design, evaluate, and develop selection criteria for desirable traits. Using path coefficient analysis, the present study was executed to estimate the phenotypic and genotypic correlation coefficients between yield and yield-related traits and to determine the direct and indirect effects of yield-related traits on kernel yield per plant. A total of 32 genotypes of groundnut were used and shown in a Randomized Block Design with three replications on two different dates at research farm of COA Gwalior and KVK Ashoknagar each in kharif 2018. Data were collected on vegetative and yield component attributes. Based on analysis of variance, pooled results showed that there were positive and highly significant differences ($p \leq 0.01$) among the 32 genotypes for all attributes studied. The estimates of genotypic and phenotypic correlation coefficient analysis revealed that the kernel yield per plant showed significant and positive correlation with pod yield per plant, harvest index, 100 pod weight, number of pod per plant, shelling outturn and 100 kernel weight. Genotypic and phenotypic path coefficient analysis revealed that shelling outturn, harvest index and pod yield per plant exerted highest positive and significant direct effect on kernel yield per plant. Therefore, it would be valuable to give due importance on the selection of these traits for fast improvement in kernel yield of groundnut.

Keywords: Correlation, analysis, environments, component, *Arachis hypogaea* L.

Introduction
Groundnut (*Arachis hypogaea* L.) is one of the important oilseed crops grown in tropical and subtropical regions of the world and is fifth in vegetable oil production among the nine major oilseed crops of world (Tillman *et al*., 2009) [15]. In groundnut, Direct selection for kernel yield would not be a reliable approach owing to its quantitative inheritance that constituted by number of yield attributes. Clear Information on contribution of each component attributes that influence the complex trait would come out through the study of correlation co-efficient and causation of path co-efficient analysis (Ashutosh *et al*., 2016) [2]. Correlation coefficient between the yield attributes and kernel yield, and information on relative importance of direct and indirect effects of these attributes on kernel yield is the requirement for crop improvement to attain the aim of augmented production by increasing the crop yield potential. Accordingly, the present research was carried out to obtain information on the association of kernel yield and its component traits, interrelationships among themselves and to assess their relative importance.

Material and Methods
Experimental Detail: The material for the present study comprised a set of 32 genotypes including high yielding 24 diverse germplasm lines and 8 selected cultivars of groundnut genotypes received from the Directorate of Groundnut Research, Junagarh, grown in a Randomized Block Design with three replications on two different dates at research farm of COA Gwalior and KVK Ashoknagar each in kharif 2018 (Table 1). The recommended packages of practices were adopted for optimum crop growth. The fertilizer was applied at the rate of 20:60:40 kg NPK/ha. The entire dose of NPK was placed in the furrow below the seed at sowing. N was applied as starter dose in groundnut as the crop derives its N requirement through its nodules. Inter row spacing of 30 cm and plant to plant spacing 10 cm were followed. Regular hand weeding as well as pest and disease control measures were carried out whenever needed. Genotypic and phenotypic correlation coefficients were obtained as suggested by Miller *et al.* (1958) [8] and path coefficient analysis was done as per Dewey and Lu (1959) [3].

Table 1: The name of germplasms and cultivars

Experimental Material			
Germplasm line			Cultivar
ICGV-13287	ICGV-13232	CGV-13542	KDG 128
ICGV-9030	ICGV-8098	ICGV-13296	GPBG4
ICGV-13528	ICGV-537	ICGV-9023	Sunoleic 95R
ICGV-13227	ICGV-13221	ICGV-13572	JGN-3
ICGV-13262	NRCG-13574	ICGV-6258	TG-26
ICGV-8026	ICGV-2890	ICGV-13260	ICGS-44
ICGV-13244	ICGV-13275	ICGV-5653	ICGV-3043
ICG-X-140068-F2	ICGV-13299	ICGV-5785	ICGV-02266

Environment and Location: Gwalior is located in the Gird region and is situated at an altitude of 211.52 MSL, 260 13´ N Latitude and 780 14´ E Longitude. The soil is sandy loam, low in available nitrogen, medium in phosphorus and high in potash with pH of 8.5. Ashoknagar is located in the northern part of Madhya Pradesh, between rivers Sindh and Betwa and is situated at an average elevation of 507 metres (1640 ft) above sea level and soil are black, brown and bhatori (stony) soil. The experiment was conducted at Research Farm, Department of Genetics and Plant Breeding, RVSKVV, College of Agriculture, Gwalior, Krishi Vigyan Kendra, Ashoknagar and molecular analysis was carried out at Plant Molecular Biology Lab, Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Gwalior (M.P.). Gwalior summer season is hot and dry, May and June are the hottest months and minimum and maximum temperatures vary from 28.5 ^{0}C to 47 ^{0}C, respectively. December and January constitutes the cooler months of the year and minimum temperature ranges from 4 ^{0}C to 7 ^{0}C. The average rainfall ranges between 80 to 90 cm most of which is received in the months of July, August and September with few showers in winter months. Ashoknagar seasons are divided into three part *viz*., summer, the rains and winter. Summer extends over the months of mid-March to mid-May. The average daily temperature during the summer months is 35^{0}C, which may rise upto 46 ^{0}C for few days. The rainy season starts with first showers of mid-June and extends to the middle of September. Ashoknagar and surrounding areas receive an average of 140 cm of rainfall a year. The average daily temperature ranges from15 ^{0}C to 20 ^{0}C.

Data collection: Observations were recorded on random five plants from each genotype in each replication for 14 quantitative characters *viz*., plant height (cm), days to 50% flowering (%), days to maturity (%), number of primary branches per plant, number secondary branches per plant, number of pods per plant, pod yield per plant (g), kernel yield per plant (g), shelling outturn (%), sound mature kernels (%), 100 pod weight (g), 100 kernel weight (g), biological yield per plant (g) and harvest index (%).Of the quantitative traits studied, days to 50% flowering, days to maturity, plant height, number of primary branches per plant and number of secondary branches per plant were verifed in the field and the remaining traits were measured in the laboratory after harvest.

Results and Discussion

Analysis of variance: The analysis of variance for all the characters *viz*., plant height (cm), days to 50% flowering, days to maturity, number of primary branches, number of secondary branches, number of pod per plant, pod yield per plant (g), shelling outturn, sound mature kernel, 100 pod weight (g), 100 kernel weight (g), biological yield per plant (g), harvest index (%) and kernel yield per plant (g) indicated the existence of highly significant differences among the genotypes (Table 2). Pooled analysis of variance for kernel yield per plant and its contributing traits was presented in Table 3. The mean sum of square due to environment were significant for all the characters except number of primary branches, 100 pod weight (g) and 100 kernel weight (g) while in genotype all the characters were significant in pooled analysis of four environmental data was studied. It indicates that there was considerable variability for these characters in the present material of groundnut genotypes.

Correlation: The study of genotypic correlation gives an idea of the extent of relationship between different variables. In general, the values of genotypic correlations were higher than corresponding phenotypic correlations. This explains that though there were high degrees of associations between two variables at genotypic level, their phenotypic expressions was suppressed by the influence of environment and are furnished in Table 4 and 5.
The estimates of genotypic and phenotypic correlation coefficient in pooled analysis revealed that the kernel yield per plant showed significant and positive correlation with pod yield per plant, harvest index, 100 pod weight, number of pod per plant, shelling outturn and 100 kernel weight. Similar association was also reported by John *et al.* (2009) [5], Dolma *et al*. (2010) [4], Zaman *et al*. (2011) [17], Sadeghi and Noorhosseini-Niyaki (2012) [11], Shoba *et al.* (2012) [12], Reddy *et al.* (2017b) [9] and Aparna *et al.* (2018) [1]. Positive association of harvest index was observed with pod yield per plant and number of pod per plant, biological yield per plant with number of secondary branches and number of primary branches, 100 kernel weight with 100 pod weight, 100 pod weight with pod yield per plant, pod yield per plant with number of pod per plant and number of secondary branches with number of primary branches and days to 50% flowering at both genotypic and phenotypic levels. Selection on the basis of genotypic correlation coefficients is more responsive as compared to that of the selection based on the phenotypic correlation coefficient. Similar findings were published earlier by Singh and Singh (2001) [13], Suneetha *et al.* (2004) [14] and Kotzamanidis *et al.* (2006) [6]. Thus, according to correlations, pod yield per plant, harvest index, shelling outturn, 100 pod weight and number of pod per plant were proved to be the outstanding characters influencing kernel yield in groundnut.

Path Coefficient: Phenotypic path coefficient is used to partition the relative contribution of yield components via standard partial regression coefficients. It provides an effective way to find out direct and indirect sources of correlation. The results of phenotypic and genotypic path coefficients were presented in Table 6 and 7.
Genotypic path coefficient analysis revealed that shelling outturn (0.6183), harvest index (0.5408) and pod yield per plant (0.4889) exerted the highest positive direct effect on kernel yield per plant whereas in phenotypic path coefficient, shelling outturn (0.7386), pod yield per plant (0.5321) and harvest index (0.4636) exerted highest positive direct effect on kernel yield per plant. This agrees with the findings of Zaman *et al*. (2011) [17], Shoba *et al.* (2012) [12], Kumar *et al*. (2014) [7] and Reddy *et al*. (2017a & 2017b) [9]. These characters could be considered as main components for selection in a breeding program for higher kernel yield. On the other hand, genotypic path coefficient revealed that number of primary branches (-0.0739), plant height (-0.0454) and days to maturity (-0.0121) showed negative direct effects on kernel yield whereas in phenotypic path coefficient number of primary branches (-0.0377), plant height (-0.0371) and 100 pod weight (-0.0158) showed negative direct effect on kernel yield per plant. It indicates that kernel yield per plant could be increased by selecting the plant with maximum number of pods, higher shelling outturn, early days to 50% flowering and days to maturity. The present findings are in agreement with Zaman *et al.* (2011) [17], Reddy *et al.* (2017b) [9] and Vange and Maga (2014) [16]. The highest positive indirect effect were observed in harvest index (0.3015) followed by 100 pod weight (0.2495), biological yield per plant (0.1677), 100 kernel weight (0.1473), sound mature kernel (0.1404) and plant height (0.1206) through pod yield per plant. Likewise, number of secondary branches (0.2207) followed by number of primary branches (0.1794) and days to 50% flowering (0.0999) via biological yield per plant; pod yield per plant (0.3335) followed by number of pod per plant (0.2378) and shelling outturn (0.0408) via harvest index and days to maturity via days to 50% flowering (0.0180). These characters exhibited significant and positive associations with kernel yield per plant. The lower residual effect (0.1270) indicated that sufficient contribution in kernel yield has been explained by the independent variables included in the analysis.

Table 2: Environment wise analysis of variance for 14 characters among 32 genotypes of groundnut

Sources		df	Plant height (cm)	Days to 50% flowering	Days to maturity	Number primary branches	Number secondary branches	Number of pod per plant	Pod yield per plant (g)	Shelling outturn	Sound mature Kernel%	100 Pod weight (g)	100 Kernel weight (g)	Biological yield per plant (g)	Harvest Index%	Kernel yield per plant (g)
Replication	1	2	24.96	14.82**	0.09	0.13	0.02	9.48	21.63**	13.50	75.43**	45.50	19.91	431.43	8.35**	1.99
	2		41.39	0.79	2.01	3.33**	0.19	21.88**	25.49**	4.28	4.14	243.17	25.45	309.11	5.34**	5.19**
	3		3.56	4.51**	5.34	1.44	1.08	3.66**	0.89	25.53	3.62	163.89	32.09**	342.8**	3.54	0.15
	4		32.16	3.50**	7.29**	1.38	0.01	22.19**	14.67**	0.41	49.57**	30.41	1.57	76.74	3.27	1.95**
Genotype	1	31	143.62**	7.47**	2.64**	4.28**	3.64**	51.67**	30.89**	35.56**	60.98**	924.07**	71.80**	1085.1**	17.7**	4.44**
	2		60.79**	5.55**	5.63**	6.52**	6.42**	30.04**	14.03**	45.94**	53.38**	846.64**	43.60**	864.89**	10.1**	5.05**
	3		145.78**	8.13**	10.10**	5.16**	10.44**	1.58**	3.69**	66.16**	63.74**	937.71**	138.74**	78.72**	4.26**	1.69**
	4		64.40**	8.92**	7.96**	2.38**	9.56**	5.67**	5.07**	41.25**	52.98**	679.23**	81.20**	75.75**	3.09**	1.96**
Error	1	62	22.99	0.99	2.17	0.58	0.16	4.95	5.31	9.86	11.49	84.35	12.85	226.09	0.96	0.66
	2		19.18	2.26	3.09	0.64	0.51	1.97	1.96	7.11	11.65	102.76	15.56	140.22	1.47	0.56
	3		17.84	0.50	1.87	0.68	0.76	1.95	1.29	9.13	10.64	74.55	13.22	47.22	1.66	0.43
	4		17.53	0.63	0.82	1.01	1.09	2.52	1.43	6.63	12.05	81.08	15.12	43.84	1.28	0.51

Figures in Parenthesis indicate - ** Significant at 1% level.
(1) = Environment-I
(2) = Environment-II
(3) = Environment-III
(4) = Environment-IV

Table 3: Pooled analysis of variance in groundnut for 14 characters over four environments

Sources	df	Plant height (cm)	Days to 50% flowering	Days to maturity	Number primary branches	Number secondary branches	Number of pod per plant	Pod yield per plant (g)	Shelling outturn	Sound mature Kernel%	100 Pod weight (g)	100 Kernel weight (g)	Biological yield per plant (g)	Harvest Index%	Kernel yield per plant (g)
Environment	3	2681.9**	62.7**	3.1**	0.5	143.9**	345.8**	140.0**	337.6**	50.0**	63.8	14.6	5898.7**	25.6**	12.9**
Genotype	31	37.0**	4.6**	4.6**	1.6**	3.8**	5.7**	5.2**	13.4**	23.2**	966.1**	57.8**	254.5**	3.6**	1.2**
G X E	93	33.7	1.8	1.4	1.5	2.1	8.0	4.2	16.5	17.9	54.4	18.0	149.1	2.8	1.1
pooled error	248	19.4	1.1	1.1	0.5	0.6	2.6	2.5	8.2	11.5	85.7	14.2	114.3	1.3	0.5
Total	383	32.2	1.3	0.7	0.5	1.9	5.1	2.5	7.7	6.6	91.9	9.2	103.5	1.2	0.5

*, ** significant at 5 and 1 percent levels, respectively

Table 4: Phenotypic correlation coefficient among 14 characters of 32 groundnut genotypes in pooled environment

Characters	Days to 50% flowering	Days to maturing	Number of primary branches	Number of secondary branches	Number of pod per plant	Pod yield per plant (g)	Shelling outturn	Sound mature Kernel%	100 Pod weight (g)	100 Kernel weight (g)	Biological yield per plant (g)	Harvest Index%	Kernel yield per plant (g)
Plant height (cm)	-0.130	0.180	-0.168	0.054	-0.114	0.192	-0.200	0.117	0.074	0.059	0.147	0.086	0.010
Days to 50% flowering		0.257	0.246	0.413**	-0.338*	-0.083	-0.126	-0.390*	-0.010	0.255	0.226	-0.224	-0.119
Days to maturity			-0.032	0.077	-0.097	-0.192	-0.054	-0.058	-0.066	-0.108	-0.136	-0.058	-0.203
Number of primary branches				0.427**	-0.221	0.072	-0.217	-0.047	0.069	0.032	0.416**	-0.279	-0.130
Number of secondary branches					-0.408**	0.006	-0.205	-0.155	0.152	0.222	0.551**	-0.399*	-0.126
Number of pod per plant						0.363*	0.064	0.224	-0.060	-0.253	-0.119	0.395*	0.378*
Pod yield per plant (g)							-0.344*	0.173	0.443**	0.255	0.350*	0.620**	0.675**
Shelling outturn								0.103	0.020	-0.051	-0.340*	-0.065	0.419**
Sound mature kernel (%)									0.055	-0.188	-0.029	0.177	0.223

100 pod weight (g)										0.626**	0.252	0.157	0.415**
100 kernel weight (g)											0.222	0.047	0.233
Biological yield per plant (%)												-0.494**	0.035
Harvest index (%)													0.580**

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

Table 5: Genotypic correlation coefficient among 14 characters of 32 groundnut genotypes in pooled environment

Characters	Days to 50% flowering	Days to maturing	Number of primary branches	Number of secondary branches	Number of pod per plant	Pod yield per plant (g)	Shelling outturn	Sound mature Kernel%	100 Pod weight (g)	100 Kernel weight (g)	Biological yield per plant (g)	Harvest Index%	Kernel yield per plant (g)
Plant height (cm)	-0.151	0.210	-0.170	0.057	-0.140	0.247	-0.287	0.175	0.092	0.082	0.205	0.090	0.032
Days to 50% flowering		0.291	0.309*	0.466**	-0.392*	-0.076	-0.208	-0.626**	-0.008	0.291	0.291	-0.266	-0.140
Days to maturity			-0.024	0.089	-0.113	-0.220	-0.120	-0.135	-0.081	-0.114	-0.163	-0.058	-0.276
Number of primary branches				0.516**	-0.311*	0.070	-0.372*	-0.012	0.077	0.025	0.522**	-0.368*	-0.226
Number of secondary branches					-0.514**	0.009	-0.314*	-0.234	0.161	0.259	0.642**	-0.474**	-0.164
Number of pod per plant						0.320*	0.124	0.348*	-0.065	-0.295	-0.231	0.440**	0.359*
Pod yield per plant (g)							-0.321*	0.287	0.510**	0.301*	0.343*	0.617**	0.755**
Shelling outturn								0.091	0.025	-0.061	-0.481**	0.076	0.345*
Sound mature kernel (%)									0.058	-0.290	-0.009	0.256	0.288
100 pod weight (g)										0.682**	0.280	0.187	0.514**
100 kernel weight (g)											0.256	0.062	0.314*
Biological yield per plant (%)												-0.508**	-0.029
Harvest index (%)													0.704**

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

Table 6: Genotypic path-coefficient direct and indirect effects of various characters on kernel yield of groundnut pulled over 4 pooled environments

Characters	Plant height (cm)	Days to 50% flowering	Days to maturing	Number of primary branches	Number of secondary branches	Number of pod per plant	Pod yield per plant (g)	Shelling outturn	Sound mature Kernel%	100 Pod weight (g)	100 Kernel weight (g)	Biological yield per plant (g)	Harvest Index (%)	Genotypic correlation with Kernel yield per plant (g)
Plant height (cm)	-0.0454	-0.0094	-0.0026	0.0126	0.0038	-0.0002	0.1206	-0.1775	0.0051	0.0012	0.0042	0.0706	0.0485	0.0316
Days to 50% flowering	0.0069	0.0619	-0.0035	-0.0229	0.0312	-0.0005	-0.0373	-0.1289	-0.0182	-0.0001	0.0149	0.0999	-0.1437	-0.1404
Days to maturity	-0.0095	0.0180	-0.0121	0.0018	0.0059	-0.0001	-0.1075	-0.0741	-0.0039	-0.0011	-0.0058	-0.0561	-0.0316	-0.2763
No. of primary branches	0.0077	0.0192	0.0003	-0.0739	0.0345	-0.0004	0.0340	-0.2302	-0.0003	0.0010	0.0013	0.1794	-0.1990	-0.2265
No. of secondary branches	-0.0026	0.0289	-0.0011	-0.0382	0.0669	-0.0007	0.0044	-0.1942	-0.0068	0.0022	0.0132	0.2207	-0.2564	-0.1636
No. of pod per plant	0.0063	-0.0243	0.0014	0.0230	-0.0344	0.0013	0.1565	0.0769	0.0101	-0.0009	-0.0151	-0.0794	0.2378	0.3593
Pod yield per plant (g)	-0.0112	-0.0047	0.0027	-0.0051	0.0006	0.0004	0.4889	-0.1987	0.0084	0.0069	0.0154	0.1180	0.3335	0.7550
Shelling outturn	0.0130	-0.0129	0.0015	0.0275	-0.0210	0.0002	-0.1571	0.6183	0.0027	0.0003	-0.0031	-0.1653	0.0408	0.3448
Sound mature kernel (%)	-0.0080	-0.0388	0.0016	0.0009	-0.0157	0.0004	0.1404	0.0563	0.0291	0.0008	-0.0149	-0.0030	0.1385	0.2878
100 pod weight (g)	-0.0042	-0.0005	0.0010	-0.0057	0.0108	-0.0001	0.2495	0.0153	0.0017	0.0135	0.0349	0.0963	0.1012	0.5138
100 kernel weight (g)	-0.0037	0.0180	0.0014	-0.0018	0.0173	-0.0004	0.1473	-0.0380	-0.0085	0.0092	0.0512	0.0880	0.0337	0.3137
Biological yield per plant (%)	-0.0093	0.0180	0.0020	-0.0386	0.0429	-0.0003	0.1677	-0.2972	-0.0003	0.0038	0.0131	0.3439	-0.2747	-0.0290
Harvest index (%)	-0.0041	-0.0165	0.0007	0.0272	-0.0317	0.0006	0.3015	0.0467	0.0075	0.0025	0.0032	-0.1747	0.5408	0.7038

Residual Effects: 0.127024

Table 7: Phenotypic path-coefficient direct and indirect effects of various characters on kernel yield of groundnut pulled over 4 pooled environments

Characters	Plant height (cm)	Days to 50% flowering	Days to maturing	Number of primary branches	Number of secondary branches	Number of pod per plant	Pod yield per plant (g)	Shelling outturn	Sound mature Kernel%	100 Pod weight (g)	100 Kernel weight (g)	Biological yield per plant (g)	Harvest Index%	Phenotypic correlation with Kernel yield per plant (g)
Plant height (cm)	-0.0371	-0.0045	0.0016	0.0063	0.0018	-0.0018	0.1024	-0.1478	0.0011	-0.0012	0.0027	0.0470	0.0398	0.0103
Days to 50% flowering	0.0048	0.0346	0.0023	-0.0093	0.0140	-0.0053	-0.0441	-0.0929	-0.0036	0.0002	0.0117	0.0723	-0.1039	-0.1192
Days to maturity	-0.0067	0.0089	0.0089	0.0012	0.0026	-0.0015	-0.1020	-0.0400	-0.0005	0.0011	-0.0050	-0.0436	-0.0268	-0.2033
Nujmber of primary branches	0.0062	0.0085	-0.0003	-0.0377	0.0145	-0.0035	0.0384	-0.1600	-0.0004	-0.0011	0.0015	0.1332	-0.1291	-0.1298
Number of secondary branches	-0.0020	0.0143	0.0007	-0.0161	0.0339	-0.0064	0.0031	-0.1517	-0.0014	-0.0024	0.0102	0.1766	-0.1850	-0.1262
Number of pod per plant	0.0042	-0.0117	-0.0009	0.0083	-0.0138	0.0156	0.1931	0.0470	0.0021	0.0010	-0.0116	-0.0383	0.1830	0.3781
Pod yield per plant (g)	-0.0071	-0.0029	-0.0017	-0.0027	0.0002	0.0057	0.5321	-0.2543	0.0016	-0.0070	0.0117	0.1121	0.2874	0.6751
Shelling outturn	0.0074	-0.0044	-0.0005	0.0082	-0.0070	0.0010	-0.1832	0.7386	0.0010	-0.0003	-0.0024	-0.1089	-0.0303	0.4194
Sound mature kernel (%)	-0.0044	-0.0135	-0.0005	0.0018	-0.0052	0.0035	0.0922	0.0761	0.0093	-0.0009	-0.0086	-0.0093	0.0821	0.2226
100 pod weight (g)	-0.0028	-0.0004	-0.0006	-0.0026	0.0052	-0.0009	0.2355	0.0147	0.0005	-0.0158	0.0287	0.0808	0.0728	0.4152
100 kernel weight (g)	-0.0022	0.0088	-0.0010	-0.0012	0.0075	-0.0040	0.1358	-0.0380	-0.0017	-0.0099	0.0459	0.0713	0.0217	0.2330
Biological yield per plant (%)	-0.0054	0.0078	-0.0012	-0.0157	0.0187	-0.0019	0.1862	-0.2511	-0.0003	-0.0040	0.0102	0.3204	-0.2291	0.0346
Harvest index (%)	-0.0032	-0.0078	-0.0005	0.0105	-0.0135	0.0062	0.3299	-0.0482	0.0016	-0.0025	0.0021	-0.1583	0.4636	0.5799

Residual Effects: 0.2113214

Conclusion

From this study, it may be concluded that improvement in kernel yield per plant could be brought through by selecting most important morphological traits like pod yield per plant, harvest index, shelling outturn, 100 pod weight and number of pod per plant that should be given due emphasis while selecting genotypes

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