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Research Note

Character association and path coefficient analysis of pod yield and yield components in virginia bunch groundnut (*Arachis hypogaea* L.)

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Abstract

Correlation and path coefficient analysis were carried out for pod yield and its component characters in 10 genotypes of Virginia bunch groundnut. The genotypic correlation coefficients were found to be of relatively higher magnitude than the corresponding phenotypic correlation coefficients, indicating strong inherent association between the characters. Correlation studies indicated that number of mature pods per plant, biological yield per plant, biological yield per hectare, 100 kernel weight, oil yield per hectare, kernel yield per plant, kernel yield per hectare and pod yield per hectare showed significant positive association with pod yield per plant both at phenotypic and genotypic levels. Path analysis studies revealed that kernel yield per plant and 100 kernel weight exerted maximum positive direct effect on pod yield per plant. Hence, it would be rewarding to give due importance on the selection of these characters for rapid improvement in pod yield of Virginia bunch groundnut.

Key words

Character association, path analysis, yield, groundnut

Groundnut is an important food and cash crop. It is primarily grown for edible oil (48-50%) as well as for direct consumption by people. Pod yield, being the most important and complex character governed by quantitative genes and is much more influenced by environmental factors in which the plant is grown. Therefore selection based on only yield performance may create confusion and give a biased result. The success of any crop improvement programme essentially depends on the genetic variability present in the crop. Information on phenotypic and genotypic interrelationship of pod yield with its components characters and also among the characters themselves would be very much useful to the plant breeder in developing an appropriate breeding strategy. But yield is a complex character and is influenced by number of traits which in turn are interrelated. The interdependence of these characters will influence pod yield either directly or indirectly and as a result the information obtained on the association of these traits become unreliable. Therefore, path coefficient analysis permits the separation of direct effects from indirect effects and gives more realistic relationship of the characters and help in effective selection. Therefore, the present study on Virginia bunch genotypes was conducted to study the correlation and path coefficients.

The experimental material for the present study consisted of ten Virginia bunch groundnut genotypes obtained from Agricultural Research Station, Kadiri. The genotypes were evaluated in a randomized block design with three replications in three environments *viz.*, late *kharif*, 2012, *rabi* 2012-13 and *Summer* 2013 at Agricultural College Farm, Bapatla, Andhra Pradesh. In each season the field was laid out in RBD with three replications. Each entry in each replication was sown in an area of 6.75 sq m^2 for Virginia bunch genotypes. As the plant stand at harvesting time was good, this plot size was used to get pod yield per hectare. Every possible effort for raising a successful crop was taken up. Intercultural operations like weeding was taken up at regular intervals. Earthing up operation was taken up after gypsum application. Necessary plant protection measures were adopted during the crop growth period in all environments. In case of characters like days to 50% flowering, days to maturity, shelling percentage, 100 kernel weight (g), harvest index, SPAD chlorophyll meter reading (SCMR) at 40, 50, 60, 70 DAS and SPAD chlorophyll meter reading at maturity, kernel yield per hectare (q), biological yield per hectare (q), pod yield per hectare (q), oil yield per hectare (q) and oil content (%) were recorded on plot basis. The chlorophyll content was measured with SPAD chlorophyll meter on 5^{th} or 6^{th} leaf from the top of each representative plant between 10 A.M and 12 noon of the day. Oil content was estimated by using Soxhelt method as described by Sadasivam and Manickam (1992). The amount of oil present in the sample was calculated by using the following formula –

$$\text{Oil in ground sample (\%)} = \frac{\text{Weight of oil (g)}}{\text{Weight of sample (g)}} \times 100$$

Whereas observations such as kernel yield per plant (g), number of mature pods per plant, biological yield per plant (g) and pod yield per plant (g) were recorded on 10 randomly selected plants per entry per replication. Pod yield per hectare was computed from pod yield per plot and expressed in quintals per hectare. The formula used is-

$$\text{Pod yield per hectare} = \frac{\text{Yield per plot (g) *}}{\text{Plot area}} \times 10000\ m^2$$

Where as * Yield per plot = Mean pod yield (g) × Plant stand at harvest (no.) (Minimum plot size for extrapolating the yield per ha is 12 m^2)

The data generated over seasons were pooled and analyzed for estimating the correlation coefficients suggested by Snedecor and Cochran, (1965) and direct and indirect effects of yield components on yield as suggested by Dewey and Lu (1959).

The phenotypic and genotypic correlations among the pod yield and yield component characters in Virginia bunch genotypes were presented in table 1. Correlation studies revealed that genotypic correlation coefficients were higher than phenotypic correlation coefficients for most of the characters under study indicating the strong inherent association between the characters which governed largely by genetic causes and generally less subjected to environmental forces. Genotypic correlation revealed the existence of real association where as the phenotypic correlations may occur by chance. The low phenotypic correlations could have resulted due to the modifying effect of environment on the association of characters at the genotypic level.

Pod yield per plant was found to be significantly and positively associated with number of mature pods per plant (r_g = 0.6860; r_p= 0.6796), biological yield per plant (r_g = 0.8874; r_p= 0.7731), biological yield per hectare (r_g = 0.8905; r_p= 0.7703), 100 kernel weight (r_g = 0.6483; r_p= 0.4961), oil yield per hectare (r_g = 0.9478; r_p= 0.9220), kernel yield per plant (r_g = 0.9746; r_p= 0.9659), kernel yield per hectare (r_g = 0.9777; r_p= 0.9615) and pod yield per hectare (r_g = 0.9812; r_p= 0.9944) at both the levels. It exhibited strong positive significant association with SCMR at 50 DAS (r_g = 0.2296) at genotypic level. It exhibited negative significant association with SCMR at 60 DAS (r_g = -0.6719), SCMR at 70 DAS (r_g = -0.3967) and SCMR at maturity (r_g = -0.6475) at genotypic level.

However, characters which were correlated genotypically but not phenotypically may not be of practical value in selection since selection is based on phenotypes as observed in case of relationship between biological yield and pod yield. Similar results were obtained by Pradhan and Patra (2011), Channayya *et al.* (2011), Babariya and Dobariya (2012) and Ravikumar *et al.* (2012).

Estimates of direct and indirect effects of individual characters towards pod yield are presented in table 2 & 3. The path coefficients revealed largest direct effects of 100 kernel weight and kernel yield per plant on pod yield. The high direct effect of these traits appeared to be the main factor their strong association with pod yield. Hence, direct selection for these traits would be effective. Days to 50% flowering exhibited positive direct effect and positive association and negative direct effect and negative association at genotypic and phenotypic levels respectively. These findings were in agreement with the reports of Suneetha *et al.* (2004) and Mane *et al.*(2008). SCMR at 40 DAS exhibited positive direct effect and positive association and negative direct effect and positive association at genotypic and phenotypic levels respectively. Under these circumstances, a restricted simultaneous selection model is to be followed *i.e.*, restrictions are to be imposed to nullify the undesirable indirect effects in order to make use of the direct effect. The indirect effects were positive mainly through kernel yield per hectare at genotypic level. These findings were in agreement with the reports of Ravikumar *et al.* (2012).

Days to maturity exhibited negative direct effect and negative association and positive direct effect and negative association at genotypic and phenotypic levels respectively. Similar findings were reported by Garjappa (2005), Vaithiyalingan *et al.* (2010) and Thirumala *et al.* (2012). Number of mature pods per plant exhibited positive direct effect and positive association and positive direct effect and negative association at genotypic and phenotypic levels. The indirect effects were positive mainly through biological yield per plant and kernel yield per plant at genotypic level. Similar findings were reported by Deshmukh *et al.* (1986), Durgarani *et al.* (1987), Rajkumar (1991), Izge *et al.* (2004) and Garjappa (2005). Biological yield per plant (g) exhibited positive direct effect and positive association and negative direct effect and positive association at genotypic and phenotypic levels. The indirect effects were positive mainly through oil yield per hectare and kernel yield per hectare at genotypic level. Similar findings were reported by Suneetha *et al.* (2004), John *et al.* (2011), Babariya and Dobariya (2012) and Thirumala *et al.* (2012).

Harvest index exhibited positive direct effect and negative association and positive direct effect and positive association at genotypic and phenotypic levels. Under these circumstances, a restricted simultaneous selection model is to be followed *i.e.,* restrictions are to be imposed to nullify the undesirable indirect effects in order to make use of the direct effect. The indirect effects were positive mainly through kernel yield per plant and biological yield per hectare. Similar results were reported by Rajkumar (1991), Vaddoria and Patel (1992) and Manoharn and Ramalingam (1993). Kernel yield per plant exhibited positive direct effect and positive association at both genotypic and phenotypic level. High direct effects and positive correlations with pod yield suggest kernel yield per plant as one of the major contributors towards pod yield and direct selection based on this trait for yield will be rewarding. Similar results were earlier reported by Abraham (1990), Sharma and Varshney (1995), Venkataramana *et al.* (2000) and Mathews *et al.* (2001).

Hundred kernel weight exhibited positive direct effect and positive association at both genotypic and phenotypic level. High direct effects and positive correlations with pod yield suggest 100 kernel weight as one of the major contributors towards pod yield and direct selection based on this trait for yield will be rewarding. Similar results were earlier reported by Deshmukh *et al.* (1986), Kuriakose and Joseph (1986), Durgarani *et al.* (1987), Abraham (1990) and Singh and Singh (2001). Oil content exhibited negative direct effect and negative association and positive direct effect and negative association at genotypic and phenotypic levels respectively. In these situations, the indirect causal factors are to be considered for yield improvement. Similar findings were earlier reported by Kumar and Yadav (1982) and Garjappa (2005).

A perusal of the results obtained from character association and path coefficient analysis, revealed that 100 kernel weight and kernel yield per plant were found to have significant influence on pod yield and also have high positive direct and indirect effects through many other characters. Hence, simultaneous selection based on 100 kernel weight and kernel yield per plant seems to be more promising in improving the pod yield in Virginia bunch groundnut.

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Table 1. Phenotypic (above diagonal) and genotypic (below diagonal) correlation among 19 characters in Virginia bunch genotypes in pooled environment

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	**1.000**	0.136	`0.039	0.013	-0.084	0.229*	0.449**	-0.132	0.011	0.002	0.063	0.273**	-0.106	0.008	0.002	0.301**	0.076	0.041	0.033
2	0.090	**1.000**	0.272**	0.299**	0.360**	-0.014	0.059	0.015	0.120	0.111	0.016	0.111	0.247*	0.135	0.134	0.204	0.204	0.068	0.065
3	-0.184	0.884**	**1.000**	0.224*	0.279**	-0.039	0.301**	0.134	0.110	0.090	-0.039	-0.117	0.185	0.085	0.074	0.284**	0.159	0.026	0.014
4	0.178	0.709**	0.459**	**1.000**	0.427**	0.345**	0.049	-0.299	-0.189	-0.171	0.069	-0.131	0.187	-0.143	-0.129	0.296**	-0.038	-0.194	-0.181
5	0.371**	0.640**	0.627**	0.817**	**1.000**	0.172	-0.006	-0.191	-0.043	-0.029	-0.081	0.071	0.042	-0.126	-0.107	0.250*	-0.021	-0.134	-0.114
6	0.558**	-0.493**	-0.625**	0.508**	0.494**	**1.000**	-0.032	-0.290**	-0.148	-0.136	0.069	0.200	0.048	-0.085	-0.081	0.201	-0.021	-0.085	-0.082
7	0.660**	0.778**	0.387**	0.361**	0.946**	0.071	**1.000**	-0.110	0.060	0.050	-0.063	-0.032	-0.269*	-0.123	-0.123	0.411**	-0.011	-0.047	-0.046
8	-0.332**	0.044	0.635**	-0.449**	-0.309**	-0.889**	-0.221*	**1.000**	0.587**	0.572**	-0.086	-0.059	0.194	0.713**	0.694**	-0.336**	0.603**	0.679**	0.662**
9	0.040	0.383**	0.508**	-0.370**	-0.041	-0.514**	0.181	0.674**	**1.000**	0.914**	-0.567**	0.338**	0.067	0.758**	0.757**	-0.086	0.750**	0.773**	0.771**
10	0.034	0.366**	0.498**	-0.398**	-0.064	-0.516**	0.169	0.677**	0.995**	**1.000**	-0.577**	0.343**	0.067	0.755**	0.764**	-0.090	0.756**	0.770**	0.777**
11	0.008	-0.405**	-0.593**	-0.043	-0.337**	0.083	-0.515**	-0.284**	-0.595**	-0.590**	**1.000**	0.057	0.048	0.001	-0.003	-0.045	-0.015	0.020	0.007
12	0.595**	0.074	-0.287**	-0.442**	-0.305**	0.044	0.247**	-0.101	0.410**	0.410**	0.286**	**1.000**	-0.056	0.436**	0.439**	0.065	0.467**	0.496**	0.498**
13	-0.277**	0.010	0.647**	0.222**	-0.104	-0.317**	-0.499**	0.591**	0.091	0.084	0.210**	-0.231*	**1.000**	0.323**	0.317**	-0.070	0.301**	0.082	0.079
14	-0.015	0.162	0.374**	-0.578**	-0.396**	-0.694**	-0.155	0.780**	0.855**	0.856**	-0.132	0.540**	0.409**	**1.000**	0.995**	-0.206	0.952**	0.966**	0.960**
15	-0.024	0.162	0.376**	-0.598**	-0.411**	-0.708**	-0.156	0.787**	0.857**	0.857**	-0.127	0.539**	0.400**	0.975**	**1.000**	-0.205	0.959**	0.962**	0.966**
16	0.491**	0.896**	0.477**	0.998**	0.897**	0.466**	0.727**	-0.423**	0.155	0.142	-0.307**	0.264*	-0.125	-0.140	-0.145	**1.000**	0.072	-0.196	-0.195
17	0.099	0.409**	0.510**	-0.345**	-0.123	-0.602**	0.043	0.673**	0.895**	0.890**	-0.197	0.616**	0.364**	0.965**	0.963**	0.128	**1.000**	0.922**	0.928**
18	0.060	0.151	0.230*	-0.672**	-0.397**	-0.648**	-0.058	0.686**	0.887**	0.891**	-0.174	0.648**	0.194	0.975**	0.978**	-0.119	0.948**	**1.000**	0.994**
19	0.050	0.146	0.231*	-0.697**	-0.414**	-0.660**	-0.060	0.692**	0.886**	0.888**	-0.166	0.647**	0.184	0.973**	0.975**	-0.126	0.943**	0.981**	**1.000**

*, **Significant at 5 and 1 per cent level, respectively

1: Days to 50% flowering; 2: SCMR at 40 DAS; 3: SCMR at 50 DAS; 4: SCMR at 60 DAS; 5: SCMR at 70 DAS
6: SCMR at maturity; 7: Days to maturity; 8: No. of mature pods per plant; 9: Biological yield per plant (g); 10: Biological yield per hectare (q)
11: Harvest index; 12: Shelling (%); 13: Kernel yield per plant (g); 14: Kernel yield per hectare (q); 15: 100 Kernel weight (g)
16: Oil content (%); 17: Oil yield per hectare (q); 18: Correlation with pod yield per plant (g)

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Table 2. Direct and indirect (phenotypic) effects of component characters on pod yield in Virginia bunch genotypes in pooled environment

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	**-0.0115**	-0.0016	-0.0005	-0.0001	0.0010	-0.0026	-0.0052	0.0015	-0.0001	0.0000	-0.0007	0.0012	-0.0001	0.0000	-0.0031	-0.0035	-0.0009
2	-0.0029	**-0.0215**	-0.0058	-0.0064	-0.0077	0.0003	-0.0013	-0.0003	-0.0026	-0.0024	-0.0003	-0.0053	-0.0012	-0.0012	-0.0024	-0.0044	-0.0044
3	-0.0009	-0.0061	**-0.0224**	-0.0050	-0.0063	0.0009	-0.0067	-0.0030	-0.0025	-0.0020	0.0009	-0.0042	-0.0011	-0.0017	0.0026	-0.0064	-0.0036
4	0.0000	0.0010	0.0007	**0.0033**	0.0014	0.0011	0.0002	-0.0010	-0.0006	-0.0006	0.0002	0.0006	-0.0005	-0.0004	-0.0004	0.0010	-0.0001
5	-0.0015	0.0067	0.0052	0.0079	**0.0185**	0.0032	-0.0001	-0.0035	-0.0008	-0.0005	-0.0015	0.0008	-0.0013	-0.0020	0.0014	0.0046	-0.0004
6	0.0026	-0.0002	-0.0004	0.0039	0.0019	**0.0112**	-0.0004	-0.0033	-0.0017	-0.0015	0.0008	0.0005	-0.0005	-0.0009	0.0023	0.0023	-0.0002
7	0.0115	0.0015	0.0077	0.0013	-0.0002	-0.0008	**0.0256**	-0.0028	0.0015	0.0013	-0.0016	-0.0069	-0.0011	-0.0031	-0.0008	0.0105	-0.0003
8	0.0009	-0.0001	-0.0009	0.0021	0.0013	0.0020	0.0008	**-0.0070**	-0.0041	-0.0040	0.0006	-0.0014	-0.0020	-0.0049	0.0004	0.0024	-0.0042
9	-0.0002	-0.0019	-0.0017	0.0030	0.0007	0.0023	-0.0009	-0.0093	**-0.0158**	-0.0157	0.0089	-0.0011	-0.0111	-0.0119	-0.0053	0.0014	-0.0118
10	0.0004	0.0175	0.0142	-0.0270	-0.0046	-0.0215	0.0079	0.0904	0.1573	**0.1580**	-0.0912	0.0106	0.1999	0.1908	0.0542	-0.0142	0.1994
11	0.0064	0.0016	-0.0040	0.0070	-0.0082	0.0070	-0.0064	-0.0087	-0.0575	-0.0585	**0.1013**	0.0049	0.0100	-0.0003	0.0058	-0.0045	-0.0015
12	0.0232	-0.0541	-0.0406	-0.0409	-0.0092	-0.0106	0.0590	-0.0424	-0.0147	-0.0147	-0.0105	**-0.2190**	-0.0705	-0.0300	0.0122	0.0153	-0.0660
13	0.0084	0.1473	0.0932	-0.1566	-0.1375	-0.0930	-0.1347	0.7805	0.8303	0.8274	0.0105	0.3534	**0.8955**	0.8921	0.4774	-0.2255	0.9433
14	-0.0001	-0.0050	-0.0028	0.0048	0.0040	0.0030	0.0046	-0.0259	-0.0282	-0.0285	0.0001	-0.0118	-0.0370	**-0.0373**	-0.0164	0.0076	-0.0358
15	0.0069	0.0028	-0.0030	-0.0033	0.0018	0.0051	-0.0008	-0.0015	0.0085	0.0087	0.0014	-0.0014	0.0990	0.0981	**0.0253**	0.0016	0.0197
16	0.0076	0.0051	0.0072	0.0075	0.0063	0.0051	0.0104	-0.0085	-0.0022	-0.0023	-0.0011	-0.0018	-0.0011	-0.0056	0.0016	**0.0252**	0.0140
17	-0.0095	-0.0256	-0.0199	0.0048	0.0027	0.0027	0.0014	-0.0756	-0.0940	-0.0947	0.0018	-0.0378	-0.1110	-0.1202	-0.0586	-0.0090	**-0.1253**
18	**0.0412**	**0.0675**	**0.0261**	**-0.1941**	**-0.1338**	**-0.0846**	**-0.0467**	**0.6796****	**0.7731****	**0.7703****	**0.0195**	**0.0815**	**0.9659****	**0.9615****	**0.4961****	**-0.1955**	**0.9220****

*, **Significant at 5 and 1 per cent level, respectively

1: Days to 50% flowering
2: SCMR at 40 DAS
3: SCMR at 50 DAS
4: SCMR at 60 DAS
5: SCMR at 70 DAS
6: SCMR at maturity
7: Days to maturity
8: No. of mature pods per plant
9: Biological yield per plant (g)
10: Biological yield per hectare (q)
11: Harvest index
12: Shelling (%)
13: Kernel yield per plant (g)
14: Kernel yield per hectare (q)
15: 100 Kernel weight (g)
16: Oil content (%)
17: Oil yield per hectare (q)
18: Correlation with pod yield per plant (g)

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Table 3. Direct and indirect (genotypic) effects of component characters on pod yield in Virginia bunch genotypes in pooled environment

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	**0.5997**	0.0541	-0.1100	0.1069	0.2223	0.5345	0.3958	-0.1992	0.0241	0.0202	0.0048	-0.1658	-0.0087	-0.0142	0.3569	0.2945	0.0591
2	0.0226	**0.2506**	0.2114	0.1775	0.1604	-0.1235	0.2949	0.0110	0.0960	0.0918	-0.1016	0.0025	0.0405	0.0407	0.0186	0.2244	0.1025
3	-0.0237	0.1146	**0.1292**	0.0593	0.0810	-0.0808	0.1500	0.0120	0.0157	0.0643	-0.0766	0.0836	0.0483	0.0485	-0.0371	0.0616	0.0659
4	0.0023	0.0090	0.0079	**0.0127**	0.0162	0.0094	0.0096	-0.0057	-0.0047	-0.0051	-0.0005	0.0028	-0.0073	-0.0076	-0.0056	0.0127	-0.0044
5	-0.1797	-0.3009	-0.3039	-0.5176	**-0.4847**	-0.2395	-0.3583	0.1095	0.0197	0.0311	0.1633	0.0505	0.1912	0.1993	0.1477	-0.5114	0.0595
6	-0.0065	0.5059	0.0073	-0.0059	-0.0058	**-0.0117**	-0.0008	0.0104	0.0060	0.0060	-0.0010	0.0037	0.0081	0.0083	-0.0005	-0.0054	0.0070
7	-0.3865	-0.8598	-0.2268	-0.2115	-0.1836	-0.0417	**-0.5855**	0.1095	-0.1059	-0.0989	0.3017	0.1920	0.0909	0.0912	-0.1445	-0.4254	-0.0251
8	-0.1998	0.0263	0.3818	-0.1702	-0.1949	-0.5349	-0.1327	**0.6014**	0.3051	0.3072	-0.1708	0.3554	0.3681	0.4741	-0.0607	-0.2526	0.8079
9	0.1568	0.4967	0.8765	-0.8466	-0.1690	-0.8092	0.8067	0.7318	**0.9076**	0.9600	-0.9321	0.3572	0.7219	0.3397	0.6005	0.6057	0.9196
10	-0.0753	-0.8199	-0.9142	0.8914	0.1434	0.9545	-0.3780	-0.9155	-0.8240	**-0.9238**	0.8320	-0.1882	-0.9157	-0.9157	-0.9173	-0.3111	-0.9926
11	0.0040	-0.3021	-0.2956	-0.0216	-0.1980	0.0916	-0.2569	-0.1915	-0.2967	-0.2939	**0.4985**	0.1045	-0.0659	-0.0631	0.1424	-0.1530	-0.9820
12	0.0126	-0.0005	-0.0296	-0.0101	0.0048	0.0145	0.0228	-0.0270	-0.0042	-0.0038	-0.0096	**-0.0457**	-0.0187	-0.0182	0.0105	0.0057	-0.0166
13	0.1269	-0.8829	-0.9102	0.9402	0.9885	0.9374	0.9279	-0.8715	-0.9312	-0.8322	0.4131	-0.9008	**0.7614**	-0.8563	-0.6182	0.9198	-0.8254
14	-0.1385	0.9519	0.8344	-0.5065	-0.4116	-0.7114	-0.9183	0.6760	0.7025	0.7019	-0.9410	0.3446	0.5910	**0.8652**	0.5161	-0.6080	0.7473
15	0.1063	0.5133	-0.0513	-0.0790	-0.0544	0.0079	0.0441	-0.0180	0.0731	0.0732	0.0510	-0.0413	0.0964	0.0962	**0.1786**	0.0472	0.1100
16	-0.1003	-0.1830	-0.0974	-0.1038	-0.1282	-0.0951	-0.1400	0.0034	-0.0317	-0.0289	0.0626	0.0256	0.0286	0.0296	-0.0540	**-0.2043**	-0.0262
17	0.1391	0.5774	0.7202	-0.3870	-0.1832	-0.5497	0.0604	0.6494	0.9162	0.8215	-0.2680	0.0132	-0.9555	0.6600	0.5148	0.1809	**0.9411**
18	**0.0599**	**0.1509**	**0.2296**	**-0.6719****	**-0.3967****	**-0.6475****	**-0.0583**	**0.6860****	**0.8874****	**0.8905****	**-0.1741**	**0.1939**	**0.9746****	**0.9777****	**0.6483****	**-0.1189**	**0.9478****

*, **Significant at 5 and 1 per cent level, respectively

1: Days to 50% flowering; 2: SCMR at 40 DAS; 3: SCMR at 50 DAS; 4: SCMR at 60 DAS; 5: SCMR at 70 DAS
6: SCMR at maturity; 7: Days to maturity; 8: No. of mature pods per plant; 9: Biological yield per plant (g); 10: Biological yield per hectare (q)
11: Harvest index; 12: Shelling (%); 13: Kernel yield per plant (g); 14: Kernel yield per hectare (q); 15: 100 Kernel weight (g)
16: Oil content (%); 17: Oil yield per hectare (q); 18: Correlation with pod yield per plant (g)