Int.J.Curr.Microbiol.App.Sci (2019) *8*(12): 2780-2785

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 12 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.812.325

Path Coefficient Analysis of Yield and Yield Component Traits in Advanced Breeding Lines of Groundnut under Well Watered and Managed End Season Drought Conditions

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Keywords

Groundnut, Normal moisture condition, Path coefficient analysis

Article Info

Accepted:
26 November 2019
Available Online:
10 December 2019

A B S T R A C T

Forty advanced breeding lines including released groundnut genotypes were used to carryout path coefficient analysis for yield and component traits under terminal drought conditions. Under both normal moisture and moisture stress conditions traits viz., plant height, primary branches per plant, shelling percentage, test weight, number of kernels per plant, kernel yield per plant and fresh weight of the seedling has direct positive effect towards pod yield. However, total length of the seedlings has direct negative effect on pod yield under both the conditions. Under normal moisture condition, the secondary branches per plant, number of immature pods per plant, harvest index and number of days to maturity have direct positive effect towards pod yield. However, percentage of sound mature kernels and number of mature pods per plant recorded a negative direct effect on pod yield. Percentage of sound mature kernels and number of pods per plant has positive direct effect whereas, number of immature pods per plant, harvest index and number of days to maturity has direct negative effect on pod yield under moisture stress condition. Nevertheless, the indirect effects were negligible. This indicates that, if other characters are kept constant, an increase in matured pods per plant and total number of pods per plant will increase the yield significantly under moisture stress condition.

Introduction

Groundnut (*Arachis hypogaea* L.) is an autogamous, segmental allotetraploid (2n=40), annual legume crop grown throughout the tropical, sub-tropical and warm temperate regions of world. In groundnut, overall pod yield is constituted by different yield components which make it a quantitatively inherited trait. Direct selection of pod yield would not be a reliable approach without giving due importance to its genetic nature, owing to its complex nature of inheritance (Dandu *et al.*, 2012). Correlation which is the

primary tool of breeding programme only provides the amount of association of characters, while path coefficient analysis measures the direct influence of one variable upon another and facilitates the separation of correlation coefficients into components of direct and indirect effects (Dewey and Lu, 1959) (Pavan *et al.,* 2013). Therefore, it is essential to identify the component characters through which yield can be improved. Hence, the present study was carried out to obtain information on the magnitude of relationship of individual yield components on yield, interrelationships among themselves and to measure their relative importance under terminal drought situations.

Materials and Methods

Forty advanced breeding lines of groundnut were evaluated under both moisture and terminal drought stress conditions for yield and its contributing traits in RCBD with two replications at College of Horticulture, Hiriyur, University of agriculture and Horticultural sciences, Shivamogga. The crop was managed as per package of practices. The moisture stress was imposed by withholding irrigation for 20 days at ninety days after sowing for the drought stress trial and normal irrigation was provided to the genotypes in normal moisture condition trial. The various yield and yield contributing characters were recorded on randomly selected plants per each genotype in each replication under both moisture stressed and non-stressed plots. The statistical analysis of the data on the individual characters was carried out on the mean values of five randomly tagged plants and analyzed by using GEN STAT 14.1 software package at ICRISAT, Patancheru, Hyderabad.

Path coefficient analysis

Path coefficient analysis was done using the correlation coefficients to ascertain the direct and indirect effects of the yield components on yield as suggested by Wright (1921) and illustrated by Dewey and Lu (1959).

Results and Discussion

The results of the present study indicated that, the analysis of variance for the yield and component traits under both normal moisture and moisture stress situation was found to be highly significant under both moisture stressed and non-stressed field conditions when analyzed separately for each environment.

This indicates that, variation exists among the genotypes for drought tolerance through various traits.

In the present study, the results of path analysis of yield and its contributing traits under both moisture and stress conditions presented in Table 1 and 2 respectively.

Under both normal moisture and moisture stress conditions traits viz., plant height, primary branches per plant, shelling percentage, test weight, number of kernels per plant, kernel yield per plant and fresh weight of the seedling has direct positive effect towards pod yield. However, total length of the seedlings has direct negative effect on pod yield under both the conditions.

The indirect effects on pod yield through other component traits were negligible. Similar positive direct effect of plant height (Babariya and Dobariya, 2012; Raut *et al.,* 2010), shelling percent (Trivikrama Reddy, 2003; Chaitanya, 2004; Lakshmidevamma *et al.,* 2004), test weight (Kalmeshwer *et al.,* 2006; Suneetha *et al.,* 2005; Chaitanya, 2004; Trivikram Reddy, 2003; Nagda *et al.,* 2001), kernel yield per plant (Venkateswarlu *et al.,* 2007 and Lakshmidevamma *et al.,* 2004) on pod yield had been reported.

Table.1 Estimates of direct (diagonal) and indirect effects (of diagonal) of yield components on pod yield at phenotypic level in groundnut genotypes under normal moisture condition

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	**0.0555**	-0.0117	0.0054	0.0250	0.0078	0.0181	-0.0187	-0.0210	-0.0194	-0.0121	-0.0118	-0.0134	-0.0185	-0.0138	0.0486
X2	0.0015	**-0.0071**	0.0007	0.0017	-0.0006	0.0017	-0.0012	0.0002	-0.0012	-0.0009	-0.0002	-0.0016	-0.0007	0.0005	0.0007
X3	0.0040	-0.0039	**0.0405**	0.0016	0.0021	0.0002	-0.0063	-0.0086	-0.0069	-0.0076	-0.0042	-0.0034	-0.0072	0.0108	0.0012
X4	-0.0074	0.0040	-0.0007	**-0.0164**	-0.0018	-0.0010	0.0031	0.002	0.0037	0.0007	0.0008	0.0025	0.0036	0.0009	-0.0049
X5	-0.0077	-0.0044	-0.0028	-0.006	**-0.0543**	-0.0092	0.0080	0.0118	0.0092	0.0090	0.0057	0.0086	0.0051	0.0041	-0.0083
X6	0.0412	-0.0301	0.0005	0.0075	0.0213	**0.1265**	-0.0231	-0.0157	-0.0235	-0.0130	0.0010	-0.0005	0.0144	0.0012	0.0293
X7	-0.1694	0.0820	-0.0786	-0.0955	-0.0742	-0.092	**0.503**	0.2577	0.4682	0.4292	0.3848	0.3340	0.3627	0.0087	-0.1394
X8	-0.0144	-0.0013	-0.0081	-0.0047	-0.0083	-0.0048	0.0196	**0.0382**	0.0231	0.0196	0.0196	0.0197	0.0232	0.0107	-0.0130
X9	0.0260	-0.0121	0.0126	0.0169	0.0126	0.0138	-0.0693	-0.0449	**-0.0744**	-0.0582	-0.0532	-0.0486	-0.0545	-0.0017	0.0212
X10	-0.0323	-0.0180	-0.0278	-0.0063	-0.0245	-0.0153	0.1264	0.0759	0.1159	**0.1482**	0.1273	0.0887	0.1051	-0.0036	-0.0224
X11	-0.0242	0.0028	-0.0120	-0.0055	-0.1200	0.0009	0.0873	0.0587	0.0817	0.0981	**0.1142**	0.0598	0.0772	0.0080	-0.0192
X12	-0.0318	0.0293	-0.0109	-0.0205	-0.0209	-0.0005	0.0878	0.0681	0.0864	0.0791	0.0692	**0.1321**	0.0746	0.0259	-0.022
X13	-0.0795	0.0242	-0.0423	-0.0518	-0.0224	0.0272	0.1718	0.1448	0.1744	0.1690	0.1612	0.1345	**0.2383**	0.0211	-0.0569
X14	-0.0136	-0.0037	0.0146	-0.0030	-0.0041	0.0005	0.0009	0.0154	0.0013	-0.0013	0.0039	0.0108	0.0049	**0.0549**	-0.0149
X15	-0.0059	0.0006	-0.0002	-0.0020	-0.0010	-0.0016	0.0019	0.0023	0.0019	0.0010	0.0011	0.0011	0.0016	0.0018	**-0.0067**
X16 (r value)	-0.258	0.0506	-0.1091	-0.159	-0.2883	0.0645	0.8912	0.5849	0.8404	0.8608	0.8194	0.7243	0.8298	0.1295	-0.2067
	Residual effect = 0.2601														

Table.2 Estimates of direct (diagonal) and indirect effects (of diagonal) of yield components on pod yield at phenotypic level in groundnut genotypes under moisture stress condition

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	**0.1643**	-0.0197	-0.0110	0.0268	0.0196	0.0118	-0.0200	-0.0291	-0.0150	-0.0133	-0.0159	0.0382	-0.0370	0.0008	0.1398
X2	0.0048	**-0.0401**	0.0032	0.0101	0.0005	0.0001	0.0027	0.0017	0.0061	0.0021	-0.0052	-0.0003	-0.0023	-0.0025	0.0050
X3	0.0139	0.0167	**-0.2083**	-0.0101	0.0086	-0.1013	0.0260	0.0480	0.0489	0.0355	0.0260	-0.0152	0.0152	-0.0599	-0.0020
X4	-0.0128	0.0196	-0.0038	**-0.0782**	0.0059	-0.0088	0.0066	0.0170	0.0027	-0.0089	-0.0046	-0.0128	-0.0015	0.0216	-0.0153
X5	0.0190	-0.0022	-0.0065	-0.0120	**0.1588**	-0.0174	-0.0058	-0.0140	-0.0017	-0.0023	-0.0310	0.0247	-0.0046	-0.0189	0.0266
X6	0.0242	-0.0006	0.1637	0.0380	-0.0369	**0.3366**	-0.0387	-0.0398	-0.0517	-0.0149	0.0310	0.0145	-0.0072	0.0554	0.0601
X7	-0.0145	-0.0079	-0.0148	-0.0100	-0.0043	-0.0137	**0.1187**	0.0298	0.0753	0.0604	0.0533	0.0214	0.0466	-0.0097	0.0003
X8	0.0404	0.0095	0.0526	0.0496	0.0201	0.0270	-0.0574	**-0.2281**	-0.1133	-0.0807	-0.0991	-0.0063	-0.0574	0.0210	0.0450
X9	-0.0417	-0.0699	-0.1073	-0.0160	-0.0050	-0.0702	0.2906	0.2275	**0.4577**	0.1465	0.1217	0.0894	0.1413	-0.0576	-0.0073
X10	-0.0152	-0.0100	-0.0320	0.0214	-0.0027	-0.0083	0.0955	0.0664	0.0601	**0.1878**	0.1089	0.0440	0.0710	-0.0314	-0.0164
X11	-0.0294	0.0391	-0.0378	0.0179	-0.0591	0.0280	0.1363	0.1319	0.0807	0.1760	**0.3035**	0.1032	0.0829	-0.0678	-0.0160
X12	0.0515	0.0016	0.0162	0.0363	0.0345	0.0096	0.0400	0.0062	0.0433	0.0519	0.0754	**0.2217**	0.0191	-0.0439	0.0679
X13	0.0075	-0.0019	0.0024	-0.0006	0.0010	0.0007	-0.0130	-0.0083	-0.0102	-0.0125	-0.0091	-0.0029	**-0.0331**	0.0039	0.0070
X14	-0.0001	-0.0008	-0.0038	0.0037	0.0016	-0.0022	0.0011	0.0012	0.0017	0.0022	0.0030	0.0026	0.0016	**-0.0133**	0.0019
X15	-0.1660	0.0244	-0.0019	-0.0382	-0.0327	-0.0348	-0.0005	0.0385	0.0031	0.0170	0.0103	-0.0598	0.0411	0.0276	**-0.1950**
X16(r value)	0.0459	-0.0422	-0.1891	0.0387	0.1099	0.1571	0.5821	0.2489	0.5877	0.5468	0.5682	0.4624	0.2757	-0.1747	0.1016
	Residual effect = 0.3016														

Where,

X1	Plant height at harvest (cm)	X9	Number of pods per plant
X2	Primary branches at harvest	X10	Number of kernels per plant
X3	Secondary branches at harvest	X11	Kernel yield per plant (g)
X4	Shelling percentage (%)	X12	Fresh weight of seedling (g)
X5	Percentage of sound mature kernels (%)	X13	Harvest index
X6	Test weight (g)	X14	Number of days to maturity
X7	Number of mature pods per plant	X15	Total seedling length (cm)
X8	Number of immature pods per plant	X16	Pod yield per plant (g)

Under normal moisture condition, the secondary branches per plant, number of immature pods per plant, harvest index and number of days to maturity have direct positive effect towards pod yield. However, percentage of sound mature kernels and number of mature pods per plant recorded a negative direct effect on pod yield.

Nevertheless, the indirect effects were negligible under moisture conditions. Similar results were reported by Trivikram Reddy, (2003) and Venkataravana *et al.,* (2000), Suneetha *et al.,* (2005), Nagda and Joshi, (2004), Trivikram Reddy (2003) and Bera and Das (2000).

Percentage of sound mature kernels and number of pods per plant has positive direct effect whereas, number of immature pods per plant, harvest index and number of days to maturity has direct negative effect on pod yield under moisture stress condition.

Nevertheless, the indirect effects were negligible. Similar trend is in line with the results of Babariya and Dobariya (2012), Raut *et al.,* (2010), Vekariya *et al.,* (2010) and Awatade *et al.,* (2009).

The low residual effect shows that the important yield components have been included in the present investigation for path analysis.

In the present study, the results of path analysis for moisture stressed field condition reflected that, yield and yield related traits *viz*., plant height at harvest, number of secondary branches per plant, number of mature pods per plant, number of immature pods per plant, number of kernels per plant, test weight, kernel yield per plant, fresh weight of seedling, harvest index and number of days to maturity had direct positive effect on pod yield. This indicates that, if other characters are kept constant, an increase in matured pods per plant and total number of pods per plant will increase the yield significantly.

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How to cite this article:

Chandrashekhara, G., Hasanali Nadaf, Harish Babu and Santosh K. Pattanshetty. 2019. Path Coefficient Analysis of Yield and Yield Component Traits in Advanced Breeding Lines of Groundnut under Well Watered and Managed End Season Drought Conditions. *Int.J.Curr.Microbiol.App.Sci.* 8(12): 2780-2785. doi: https://doi.org/10.20546/ijcmas.2019.812.325