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Genetic Correlation and Path-Coefficient Analysis of Oil Yield and its Components in peanut (*Arachis hypogaea* L.) genotypes under Drought and Non-drought Stress Condition

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ABSTRACT

Increasing of oil yield one of the most important goals in peanut (*Arachis hypogaea* L.) breeding programs. The objectives of this research were interrelationship between oil yield and its components on 23 peanut genotypes under drought stress and irrigated conditions. In each condition, a randomized complete block design with three replications was used. The correlation coefficients revealed that in both conditions, seed yield, total no. of kernels per plant, plant height and 100- seed weight had a high positive with oil yield. Path analysis suggested that in irrigated condition total no. of kernels per plant and seed yield and in drought stress condition 100- seed weight, seed yield and biomass had greatest positive direct effects on seeds yield. High direct effects were contributed by total no. of kernels per plant in non-drought condition and 100- seed weight in drought condition although the later had positive association with oil yield. Moreover, it was noticed that high indirect contribution was via total no. of kernels per plant and seed yield by most of the oil yield components and hence these two parameters (total no. of kernels per plant and seed yield) should be given more consideration while deciding about selection criteria of genotypes under irrigated conditions, while in drought stress conditions, 100- seed weight and seed yield had more important for selection.

KEY WORDS: peanut, drought stress, path-coefficient, oil yield.

INTRODUCTION

Peanut is widely used as an oilseed crop around the world. Several species of peanut have been cultivated for their edible seeds, but only *Arachis hypogaea* L. has been domesticated and widely distributed. In Iran, the spreading Virginia types are generally grown under rainfed conditions. Oil yield is a complex and poly genetically controlled highly environmental influenced trait governed by the interaction of many variables and selection if based merely on yield is not effective. The relationships between oil yield and reproductive characters may be altered by drought. So far, important characters determining oil yield under drought and those affecting the response of peanut genotypes to drought as far as reproductive characters and oil yield are concerned are not well understood(Knauft and Wynne, 1995; Reddy et al., 2003; Habibullah et al., 2007). Correlation analysis is a biometrical technique to find out the nature and degree of association between various physico-chemical traits indicating yield, while path analysis splits the correlation coefficient into direct and indirect effect so as to measure the relative contribution of each variable towards yield (Nunes da Luz et al., 2011). Therefore information derived from the correlation coefficients can be augmented by partitioning correlations into direct and indirect effects by path coefficient analysis. In literature, several studies have demonstrated the utility of correlation analysis in peanut selection based on plant and reproductive traits (Lakshmaiah et al. 1983, Bera and Das 2000, Nautiyal et al. 2002, Khan et al. 2001, Kotzamannidis et al. 2006, Sharma and Dashora 2009, Gomes and Lopez 2005). Korat et al. (2010) revealed that oil yield had signification positive association with shelling percentage, and 100 kernel weight, while day to maturity had negative correlation with oil yield. The direct and indirect effect obtained from path analysis revealed that oil yield was positively associated with 100-kernel weight and shelling percentage, while days to maturity and sound mature kernel percent (SMK%) had negative association with oil yield. Mane et al. (2008) revealed that 100-kernel weight showed the highest but non-signification correlation with oil yield. path coefficient analysis indicated that 100-kernel weight had the highest direct effect on oil yield followed by number pods per plant and number seeds per pod and SMK %. Sharma and Dashora (2009) reported that only number of mature pods per plant was positively and significantly correlated with oil yield. Path analysis showed that 100 pods weight had height positive direct effect on oil yield. The present study was conducted to evaluate the available groundnut germplasm for yield and its parameters and to measure the extent of direct and indirect causes of association among traits through path coefficient analysis, to furnish the information for selection of suitable criteria for predicting the oil yield in groundnut.

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MATERIALS AND METHODS

In this study, 23 groundnut genotypes were evaluated to investigate the relationship among agronomic traits in groundnut under drought stress and irrigated condition in the research field of the Islamic Azad University of lahijan, Iran during 2010 and 2011. In each condition, a randomized complete block design with three replications was used. Each genotype was accommodated in a single row of 3.0 m length with a spacing of 45 cm between rows and 20 cm between plants within the rows. The experiment was surrounded by guard rows to avoid damage and boarder effects. The irrigated condition were watered at planting, tillering, jointing, flowering and grain filling stages drought stress condition received no water other than rainfall. Observations were recorded on 10 randomly chosen competitive plants from each replication for nine characters viz., oil content(%), seed yield(kg/ha), protein content(%), 100- seed weight (gr), biomass, total no. of kernels per plant, 100-pod weight(gr) and Plant height(cm). The correlation coefficients were calculated as per Snedecor (1957). Path coefficients were estimated according to Dewey and Lu (1959), where oil yield per plant was kept as resultant variable and other contributing characters as causal variables. Correlation and Path analysis were conducted for both sites normal and stress by using SPSS software, separately.

RESULTS AND DISCUSSION

Correlation Analysis

The results of the Correlation Coefficient among the traits studied in both conditions are shown in Table 1. The results of correlation analysis showed that all characters were positively correlated with oil yield in both conditions. The results of our study are in agreement with Mane et al., (2008), Sharma and Dashora (2009) who reported positive correlations between seed yield and oil yield in peanut. Seed yield showed the highest correlation value with oil yield compared to other characters ($r = 0.751$) in both conditions. A high and positive and significant correlation ($P < 0.01$) was observed total no. of kernels per plant, plant height and oil yield using both conditions ($r = 0.447$and $r = 0.457$ in non-drought stress, $r = 0.520$ and $r = 0.358$ in drought stress condition, respectively). Savaliya et al. (2008) and Painawadee et al. (2009) observed positive and highly significant correlations of oil yield with total no. of kernels per plant in drought stress condition. Gomes and Lopez (2005), Mane et al. (2008), Korat et al. (2010) and Nunez da Lus et al. (2011) recorded positive and highly significant correlation between plant height, total no. of kernels per plant, total no. of pods per plant and oil yield in non-drought stress condition. On the other hand, positive and significant correlation ($P < 0.01$) was recorded between 100-seed weight and oil yield only in non-drought stress ($r = 0.305$). In both conditions, correlation between total no. of kernels per plant and seed yield was a statistically significant and positive ($P < 0.01$). The result is in conformity with Khanpara et al. (2010) and Sharma and Dashora (2009). Positive relationship between 100-seed weight and oil content was statistically significant ($P < 0.01$) in both conditions that confirm with result recorded Kotzamanidis et al. (2006) and Jogloy et al. (2010). We obtained that there was a statistically significant and negative correlation between oil content and seed yield in non- drought stress, while in drought stress was a statistically significant and positive. In addition, correlation between protein content and oil content was positive only in drought stress condition.

Path Analysis: Eight characters of path coefficient which had direct and indirect effects on oil yield and rates of linear correlation are summarized in Table 2 and 3. Considering rates of direct effect on oil yield, the highest value was taken from total no. of kernels per plant (0.321) in non-drought stress, after that the direct effect of seed yield and 100- pod weight on oil yield were the highest and positive (0.217, 0.125, respectively). Similar results were reported in normal condition by Songsri et al. (2008), Sumathi and Muralidharam (2007) and Mane et al. (2008). In drought stress condition the highest value was taken from 100-seed weight (0.425) and after that the direct effect of seed yield and biomass were the highest and positive (0.285, 0.110, respectively) that agree with the proposed results by Khan et al. (2001), John et al. (2007) and Painawadee et al. (2009). The direct effects of all characters under study were positive on oil yield in both conditions.

The indirect effect total no. of kernels per plant via seed yield, biomass and plant height was high and positive in non-drought stress, while in drought stress, the indirect effect 100-seed weight via all traits was height and positive that confirm with result recorded Painawadee et al. (2009) and Saeidi Nia et al. (2011). However, it may be emphasized that direct effect total no. of kernels per plant and 100- pods weight was low in drought stress but indirect effect of this traits via seed yield and 100-seed weight was as high as its genotype correlation with oil yield.

In non- drought stress, Higher and significant correlation of oil yield with total no. of kernels per plant and 100-seed weight and the highest direct contribution of total no. of kernels per plant and 100-seed weight to oil yield and great indirect contribution of most of the traits via total no. of kernels per plant and 100- seed weight suggests that seed yield per plant was dependent on these two traits.

Conclusion

Positive and significant association and higher contribution made to oil yield suggested that total no. of kernels per plant and 100-seed weight in non- drought stress and only 100- seed weight in drought stress should be given due emphasis as selection criteria for synthesis of improved genotypes.

Table1. Genotype correlation coefficients among 9 characters 23 groundnut genotypes in both conditions (non-drought stress and drought stress)

	environment	Oil content (%)	Seed yield (kg/ha)	Protein content (%)	100- seed weight(gr)	biomass	Total no. of kernels per plant	100- pod weight(gr)	Plant height (cm)
Oil yield(kg/ha)	N	0.151	0.751**	0.112	0.112	0.247*	0.447**	0.251*	0.457**
	D	0.125	0.725**	0.159	0.305**	0.115	0.520**	0.301**	0.358**
Oil content (%)	N		-0.312**	-0.010	0.625**	0.051	0.341**	0.101	0.111
	D		0.347**	0.212*	0.585**	0.051	0.411**	0.121	0.105
Seed yield(kg/ha)	N			0.105	0.527**	0.512**	0.712**	-0.237*	0.091
	D			0.415**	-0.101	0.560**	0.425**	-0.101	0.257*
Protein content (%)	N				0.525**	0.325**	0.241*	-0.011	0.251*
	D				0.421**	0.411**	0.205*	-0.091	0.301**
100-seed weight (gr)	N					0.425**	-0.241*	0.121	0.012**
	D					0.511**	0.011	0.125	0.011
biomass	N						-0.112	0.257*	0.112
	D						0101	0.101	-0.115
Total No. of kernels per plant	N							0.621**	0.285*
	D							0.285**	0.321**
100-pod weight (gr)	N								0.285*
	D								0.321**

***, ** significant at 5% and 1% levels, respectively   N: Non - drought stress   D: Drought stress**

Table2. Direct (diagonal) and indirect (non-diagonal)effects of 8 characters on oil yield in 23 groundnut genotypes in non-drought stress conditions

	Oil content (%)	Seed yield(kg/ha)	Protein content (%)	100- seed weight (gr)	biomass	Total no. of kernels per plant	100- pod weight (gr)	Plant height(cm)	Genotypic correlation with oil yield
Oil content (%)	**0.019**	0.125	-0.001	-0.018	-0.003	0.118	-0.090	0.001	0.151
Seed yield(kg/ha)	0.020	**0.217**	-0.020	0.120	0.113	0.421	0.018	0.002	0.751**
Protein content (%)	0.100	-0.001	**0.004**	-0.140	0.090	0.251	-0.001	-0.127	0.112
100- seed weight(gr)	0.251	-0.020	-0.001	**0.120**	-0.127	0.001	0.005	-0.139	0.112
biomass	-0.161	-0.021	-0.005	0.001	**0.158**	0.350	0.028	-0.003	0.247*
Total no. of kernels per plant	-0.084	0.125	0.025	-0.115	0.210	**0.321**	-0.018	-0.017	0.447**
100- pod weight (gr)	-0.020	0.110	-0.055	-0.025	0.025	-0.010	**0.125**	0.101	0.251*
Plant height (cm)	0.002	0.010	0.010	0.019	-0.009	0.325	-0.001	**0.101**	0.457**

Residual effect: 0.1125

***, ** significant at 5% and 1% levels, respectively   N: Non - drought stress   D: Drought stress**

Diagonal values (Bold letters) indicate direct effects of respective characters

Table3. Direct (diagonal) and indirect (non-diagonal)effects of 8 characters on oil yield in 23 groundnut genotypes in drought stress conditions

	Oil content (%)	Seed yield(kg/ha)	Protein content (%)	100- seed weight (gr)	biomass	Total no. of kernels per plant	100- pod weight (gr)	Plant height (cm)	Genotypic correlation with oil yield
Oil content (%)	**0.059**	0.099	-0.010	0.128	0.012	0.001	-0.009	-0.075	0.125
Seed yield(kg/ha)	-0.007	**0.285**	-0.074	0.317	0.123	0.151	-0.078	0.008	0.725**
Protein content (%)	-0.003	0.125	**0.068**	0.025	0.003	-0.067	0.009	-0.001	0.159
100- seed weight(gr)	-0.115	0.010	-0.045	**0.425**	-0.030	-0.005	0.120	-0.055	0.305**
biomass	-0.307	-0.001	0.002	0.317	**0.110**	0.005	-0.010	0.001	0.115
Total no. of kernels per plant	0.007	0.200	-0.200	0.257	-0.007	**0.093**	-0.002	-0.008	0.520**
100- pod weight(gr)	-0.009	0300	-0.050	0.257	-0.061	0.020	**0.005**	0.100	0.301**
Plant height(cm))	0.005	0.178	-0.120	0.201	-0.005	0.070	0.050	**0.105**	0.358**

Residual effect: 0.1255

***, ** significant at 5% and 1% levels, respectively   N: Non - drought stress   D: Drought stress**

Diagonal values (Bold letters) indicate direct effects of respective characters

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