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Genotypic and phenotypic correlations and path coefficient analysis for oleic acid content in sunflower

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Abstract: Correlation and path coefficient analysis was studied in sunflower. Forty nine crosses along with 14 parents were selected to access the relationship among oleic acid content and other agronomic traits. Observations were recorded on 11 traits *viz.,* days to fifty per cent flowering, leaf size, stem girth, number of leaves per plant, head diameter, days to maturity, plant height, test weight, yield per plant, oil content and fatty acid content. Randomized block design (RBD) was followed with two replications. Results revealed that days to 50 per cent flowering had significant positive correlation with days to maturity and negative correlation with head diameter at genotypic and phenotypic level. Plant height had significant positive correlation with head diameter, stem girth and oleic acid content at genotypic and phenotypic level. Head diameter had significantly positive correlation with stem girth at genotypic and phenotypic level. Yield per plant had significantly positive correlation with oleic acid content. Path coefficient analysis showed that, plant height and yield per plant had highest positive direct effect on oleic acid content at genotypic and phenotypic level. It is concluded that plant height and yield per plant can be good selection criteria for achieving improvement for oleic acid content in sunflower.

Key words: Agronomic traits, Correlation coefficient, Path analysis, Sunflower

Introduction

Sunflower (*Helianthus annuus* L.) is an annual oil seed crop belongs to the family *Asteracae*, and it is highly cross pollinated. It is taking prime position in the oilseed economy both at national and global level, mainly because of quality oil and poly unsaturated fatty acid. In India sunflower is being grown over an area of 0.55 million hectares with production of 0.41 million tonnes with productivity of 752 kg ha^{-1}. Presently Karnataka is the leading state in the country contributing 63.76 per cent and 53.70 per cent of total area and production, respectively. It is the second important oilseed crop after groundnut in the state having an area of 0.35 million hectares with production of 0.21 million tonnes. However, productively (597 kg ha^{-1}) is lesser than the national average of 752 kg ha^{-1} (Anon., 2015).

Sunflower oil is light in colour, bland flavour, high smoke point and good nutritional quality. The oil content varies from 30 to 48 per cent. The fatty acid composition reveals: palmitic acid (SFA): 5-8 per cent, stearic acid (SFA) 4-6 per cent, oleic acid (MUFA) omega-9 (18:1): 25-30 per cent, lenoleic acid (PUFA) omega-6 (18:2): 60-72 per cent and also quality protein 14-19 per cent (Zhou *et al.,* 2013). It holds second position in world in edible oil manufacturing followed by soybean oil and found to be rich in minerals like magnesium, iron, copper, calcium, zinc, sodium, potassium, phosphorus, selenium and manganese and grouped among prominent plant oils for human diet due to its nutritional values (Skoric *et al.,* 2008). It is nutritionally important because the proportion of oleic acid and linoleic acid content which determines the proportion of poly unsaturated fatty acid.

Correlation coefficient is very important to define the traits that directly affect to the seed yield. The path coefficient analysis is one of the statistical tools which is used to determine the direct or indirect effects of any yield component on oleic acid content. Correlation coefficient and path coefficient analysis assist to identify the traits that are useful as selection criteria to improve seed yield and oleic acid content. The objective of this research were to determine the correlation among oleic acid content and some agronomic traits and to determine the direct and indirect effects of certain traits on oleic acid content in sunflower.

Material and methods

The research work was carried out during summer 2014 at Main Agricultural Research Station, University of Agricultural Sciences, Raichur, Karnataka, India. In present investigation, 49 crosses were derived from crossing between seven CMS and seven restorer lines and all the crosses along parents and check are evaluated in randomized block design (RBD) with two replications with a plot size of 3m x 1.2m (two rows of three meter length) and each treatment a row length of 3 m length with a spacing of 60 x 30 cm and intra row spacing of 30 cm with inter row spacing of 60 cm. At field maturity of the crop, all the heads were harvested separately, seeds were cleaned, dried and analysed for other traits.

Observations were recorded on 11 morphological traits *viz.,* days to fifty per cent flowering, leaf size, stem girth, number of leaves per plant, head diameter, days to maturity, plant height, test weight, yield per plant, oil content and fatty acid content. Oil content was analysed by using NMR (Nuclear Magnetic Resonance) available at MARS, Raichur. The seed samples of each entry were analysed for their fatty acid profile with the help of gas chromatography available at Indian Institute of Oil seed Research, Hyderabad.

The data collected for aforesaid plant traits were statistically analysed. Correlation coefficient at genotypic and phenotypic levels were estimated from the analysis of variance and according to the procedure given by Singh and Chaudhary (1977) and path coefficient analysis was done as per method suggested by Dewey and Lu (1959).

Results and discussion

The results of genotypic and phenotypic correlations and path coefficient analysis for 11 different characters in sunflower are presented in Table 1.

Genotypic and phenotypic correlations for 11 different characters in sunflower revealed that days to 50 per cent

Table 1. Genotypic and phenotypic correlation coefficients for 11 characters in sunflower (*Helianthus annuus* L.)

Character	r	Days to maturity	No. of leaves	Plant height (cm)	Head diameter (cm)	Test weight (g)	Stem girth (cm)	Oil content (%)	Leaf size (cm)	Yield per plant(g)	Oleic acid (%)
Days to 50 % flowering	rg	0.433**	-0.268	-0.083	-0.342*	-0.180	-0.156	-0.084	-0.211	0.042	0.156
	rp	0.417*	-0.257	-0.075	-0.315*	-0.169	-0.142	-0.074	-0.187	0.036	0.153
Days to maturity	rg		-0.180	-0.082	-0.085	-0.205	0.005	0.089	0.023	0.029	0.212
	rp		-0.175	-0.076	-0.075	-0.195	-0.001	0.080	0.016	0.023	0.208
No. of leaves	rg			0.227	0.103	0.038	0.046	-0.100	0.012	-0.139	0.108
	rp			0.229	0.089	0.039	0.042	-0.096	0.011	-0.135	0.107
Plant height (cm)	rg				0.328*	-0.057	0.336*	-0.132	-0.048	0.243	0.525**
	rp				0.311*	-0.052	0.328*	-0.132	-0.046	0.233	0.521**
Head diameter (cm)	rg					0.275	0.432**	-0.017	0.130	0.132	0.225
	rp					0.244	0.414*	-0.014	0.129	0.126	0.243
Test weight (g)	rg						0.089	0.091	-0.024	-0.087	0.025
	rp						0.083	0.093	-0.024	-0.081	0.025
Stem girth (cm)	rg							-0.109	0.254	0.124	0.195
	rp							-0.103	0.265	0.115	0.193
Oil content (%)	rg								-0.088	-0.057	-0.193
	rp								-0.076	-0.059	-0.189
Leaf size (cm)	rg									0.115	-0.149
	rp									0.111	-0.144
Yield per plant (g)	rg										0.427*
	rp										0.418*

Table 2. Direct and indirect effects at genotypic and phenotypic level for oleic acid trait in sunflower (*Helianthus annuus* L.)

Character	Days to 50 % flowering	Days to maturity	No. of leaves	Plant height (cm)	Head diameter (cm)	Test weight (g)	Stem girth (cm)	Oil content (%)	Leaf size (cm)	Yield per plant (g)	Genotypic/ phenotypic correlation coefficient with oleic acid(%)
Days to 50 % flowering	0.100	0.043	-0.027	-0.008	-0.034	-0.018	-0.015	-0.008	-0.021	0.004	0.156
	0.108	0.045	-0.027	-0.008	-0.034	-0.018	-0.015	-0.008	-0.020	0.003	0.153
Days to maturity	0.114	0.263	-0.047	-0.021	-0.022	-0.054	0.001	0.023	0.006	0.007	0.212
	0.103	0.248	-0.043	-0.018	-0.018	-0.048	-0.001	0.019	0.004	0.005	0.208
No. of leaves	-0.030	-0.020	0.113	0.025	0.011	0.004	0.005	-0.011	0.001	-0.015	0.108
	-0.028	-0.019	0.110	0.025	0.009	0.004	0.004	-0.010	0.001	-0.015	0.107
Plant height (cm)	-0.032	-0.031	0.087	0.385	0.126	-0.022	0.129	-0.051	-0.018	0.093	0.525**
	-0.029	-0.029	0.088	0.384	0.119	-0.020	0.126	-0.050	-0.017	0.089	0.521**
Head diameter (cm)	-0.039	-0.009	0.011	0.037	0.114	0.031	0.049	-0.002	0.015	0.015	0.225
	-0.034	-0.008	0.098	0.034	0.109	0.026	0.045	-0.001	0.014	0.013	0.243
Test weight (g)	-0.022	-0.025	0.004	-0.007	0.034	0.124	0.011	0.011	-0.003	-0.010	0.025
	-0.019	-0.022	0.004	-0.006	0.028	0.116	0.009	0.010	-0.002	0.009	0.025
Stem girth (cm)	-0.001	0.001	0.001	0.001	0.001	0.001	0.001	-0.001	0.001	0.001	0.195
	-0.002	0.001	0.001	0.005	0.006	0.001	0.015	-0.001	0.004	0.001	0.193
Oil content (%)	0.012	-0.013	0.015	0.020	0.002	-0.014	0.016	-0.152	0.013	0.008	0.193
	0.010	-0.011	0.013	0.018	0.002	-0.013	0.014	-0.140	0.010	0.008	0.189
Leaf size (cm)	0.038	-0.004	-0.002	0.008	-0.023	0.004	-0.046	0.016	-0.182	-0.021	0.149
	0.033	-0.002	-0.002	0.008	-0.022	0.004	-0.046	0.013	-0.176	-0.019	0.144
Yield per plant (g)	0.014	0.010	-0.048	0.084	0.045	-0.030	0.042	-0.020	0.039	0.345	0.427*
	0.012	0.007	-0.046	0.079	0.042	-0.027	0.039	-0.020	0.037	0.338	0.418*

Residual effect = 0.690 (genotypic), residual = 0.702 (phenotypic), bold numbers = direct effect. *, ** are significant at 5 and 1 per cent respectively.

flowering had significantly positive correlation with days to maturity (0.433 and 0.417) and negative correlation (-0.342 and -0.315) with head diameter at genotypic and phenotypic level. Plant height had significantly positive correlation (0.325 and 0.311) with head diameter, stem girth (0.336 and 0.328) and plant height and yield per plant had significant positive association with oleic acid content (0.525 and 0.521) at genotypic and phenotypic level. Similar relationship was reported by Anandhan *et al.* (2010). Head diameter had significantly positive correlation with stem girth at genotypic and phenotypic level and yield per plant had significantly positive correlation with oleic acid content. Genetic correlations between different traits may be attributed to linkage, pleiotropy or developmentally induced functional relationships (Sowmya *et al.,* 2010).

The purpose of using the path coefficient analysis in this study was to obtain further information about the interrelationships between the oleic acid content and other agronomic traits. In Table 2 the direct and indirect effect of different traits on oleic acid content are presented. Path coefficient analysis showed that, plant height (0.385 and 0.384) and yield per plant (0.345 and 0.338) had positive and high direct effect on oleic acid content at genotypic and phenotypic level, these results indicate that increase in plant height and yield per plant causes for increase in oleic acid content. The varying results could be attributed to different agro-climatic conditions in which crop were raised. Selection of the traits showing significant correlations at genotypic and phenotypic levels coupled with the highest direct effects could be worthwhile in future for improving oleic acid content. The traits which were involved in producing the high values of genotypic and phenotypic correlation also produced the high values of path coefficient analysis. Positive direct effect of these traits was associated with highly significant and positive correlations with oleic acid content.

It was concluded that days to fifty percent flowering had significant positive association with days to maturity, plant height had significant association with head diameter and stemgirth. The path coefficient analysis revealed that plant height and yield per plant had direct positive effect on oleic acid content, which could be used as good selection criteria for selecting high oleic acid genotypes in sunflower.

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