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PATH ANALYSIS OF OIL YIELD IN SUNFLOWER (*HELIANTHUS ANNUUS* L.) HYBRIDS

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ABSTRACT

Genotypic correlations and path coefficients were computed in sunflower hybrids. Oil yield, oil content, fatty acids and other morphological characters were studied. Oil yield exhibited significant positive correlation with oil content and negative correlation with stem rot infection, whereas oil content showed positive association with stem thickness and negative correlation with stem rot infection. Stem thickness had significant positive correlation with plant height. Oleic acid showed highly significant negative correlation with linoleic and linolenic acids, whereas linoleic acid had significant positive association with linolenic acid. High positive direct effects on oil yield were shown by oil content, 100-seed weight, head diameter and oleic acid content, however plant height and palmitic acid content had direct negative effects on oil yield through stem thickness and linolenic acid. This investigation revealed that oil content, 100-seed weight, head diameter, stem thickness, stem rot resistance and high oleic acid content may be given high priority for the improvement of oil yield in sunflower hybrid breeding.

Key words: Sunflower hybrids, path analysis, oil yield, fatty acids.

In India, sunflower (*Helianthus annuus* L.) is grown in an area of 1.4 m hectares with a production of 0.6 million tonnes, thus giving an average productivity of 429 kg/ha as against the world average of 1429 kg/ha. The highest average yield of 2308 kg/ha has been reported from France. In order to increase the potential of sunflower hybrids for oil yield, an understanding of the relationships among different plant traits, oil content and different fatty acids is of immense importance. Besides, a knowledge about the direct contribution of different traits to oil yield would be highly useful for formulating a selection criterion which will combine high oil yield and other quality traits. Therefore, the present study on path analysis of oil yield in 22 hybrid populations was undertaken.

MATERIALS AND METHODS

Twenty two F_1 hybrids were used in this study. The hybrids were planted on March 3, 1990 in 3 m long 7 row plots with four replications. Three seeds were planted per hill at a distance of 30 cm between hills and 60 cm between rows. One month after germination, thinning was done and only one plant per hill was retained. The crop matured by the 15 June. At maturity, data were recorded on 10 random plants in each replication for five characters (Table 1). 100-seed weight was recorded from a composite sample of 10 plants. The seed yield was also recorded on 10 plants. Oil content was estimated from a composite sample of each replication. The oil content was estimated by wide line NMR (New Port Analyzer Model MK III A, England). The oil yield was calculated from oil content and seed yield per plant. Methyl esters of fatty acids were prepared and analysed by gas liquid chromatography using an AIMIL 5700 series gas chromatograph with flame ionization detector. Single plant data averaged from 10 plants over 4 replications were used for statistical analysis. Phenotypic and genotypic correlations with computed according to Panse and Sukhatme [1]. Genotypic correlations were used to perform the path analysis of oil yield [2].

RESULTS AND DISCUSSION

Oil yield exhibited highly significant positive correlation with oil content and negative correlation with stem rot infection. The stem rot infection adversely affected the synthesis of oil in the kernels which led to negative association of oil content and oil yield with stem rot. In a study on hybrids, Rao [3] reported that achene yield was positively correlated with

Table 1. Genotypic correlations of oil yield with important morphological traits and different fatty acids

Characters	Oil yield	100-seed weight	Head diameter	Stem thickness	Plant height	Stem rot infection	Oil content	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid
100-seed weight	-0.06										
Head diameter	-0.12	0.63**									
Stem thickness	0.22	-0.63**	-0.68								
Plant height	0.38	-0.34	-0.62**	0.96**							
Stem rot infection	-0.43*	-0.54**	0.12	-0.41	-0.21						
Oil content	0.67**	-0.10	-0.22	0.42	0.38	-0.36					
Palmitic acid	0.06	-0.09	-0.27	0.25	0.09	0.37	0.01				
Stearic acid	-0.35	-0.81**	-0.47*	0.09	-0.09	-0.35	-0.57**	-0.22			
Oleic acid	-0.35	-0.12	-0.51*	0.35	0.42	0.38	-0.25	-0.04	-0.06		
Linoleic acid	0.34	0.17	0.56**	0.40	-0.44*	0.01	0.26	0.04	-0.06	-1.00**	
Linolenic acid	0.19	0.22	-0.45*	-0.29	-0.13	0.55**	-0.27	0.19	0.40	-0.55**	0.56**

*,**Significant at 5% and 1% levels, respectively.

Table 2. Direct (in bold) and indirect effects of different characters on oil yield

Charater	100-seed weight	Head diameter	Stem thickness	Plant height	Stem rot infection	Oil content	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid	Genotypic correlation with oil yield
100-seed weight	**0.59**	-0.03	0.16	-0.09	0.10	-0.29	-0.36	0.01	0.18	0.81	-0.53	-0.06
Head diameter	-0.03	**0.50**	-0.82	0.27	-0.09	0.36	0.05	-0.02	-0.40	0.33	-0.27	-0.12
Stem thickness	-0.07	0.38	**-1.30**	0.29	-0.16	0.08	0.12	-0.04	-0.23	1.35	0.87	0.22
Plant height	0.13	-0.38	0.88	**-0.43**	0.25	-0.28	-0.23	0.04	0.04	0.94	0.62	0.38
Stem rot infection	0.22	-0.20	0.80	-0.41	**0.26**	-0.14	-0.21	0.01	-n0.04	-1.11	0.69	-0.43
Oil content	-0.25	0.32	-0.16	0.18	-0.05	**0.67**	0.19	-0.06	-0.18	-0.10	-0.02	0.67
Palmitic acid	0.39	-0.06	0.28	-0.18	0.10	-0.24	**-0.54**	0.02	-0.28	0.67	-0.40	0.06
Stearic acid	0.04	-0.06	0.34	-0.11	0.02	-0.25	-0.01	**0.17**	-0.11	0.09	0.06	-0.35
Oleic acid	-0.21	-0.48	0.61	-0.04	-0.02	-0.24	0.31	-0.31	**0.50**	-0.08	0.10	-0.30
Linoleic acid	-0.18	-0.07	0.66	-0.15	0.11	0.02	0.14	-0.01	0.02	**-2.65**	1.55	0.34
Linolenic acid	0.20	0.10	-0.72	0.17	-0.11	0.01	-0.14	-0.01	-0.03	2.66	**-1.56**	0.19

Explained variation: 2.09. Unexplained variation: –1.09.

capitulum diameter, oil content and 100-achene weight. Oil content showed positive association with stem thickness and negative correlation with stem rot infection and stearic acid content. 100-seed weight had significant positive correlation with head diameter and negative association with stem thickness, stem rot infection and stearic acid content. Head diameter exhibited significant negative correlation with stem thickness, plant height, stearic acid, oleic acid and linolenic acid but it had positive correlation with linoleic acid. Oleic acid exhibited highly significant negative correlation with linoleic and linolenic acids, whereas linoleic acid had significant positive association with linolenic acid and negative association with plant height. Andrich et al. [4] also reported that there was a high negative correlation between the contents of oleic and linolenic acids. This information will aid in selecting genotypes with desired lipid composition.

High positive direct effects on oil yield were given by oil content, 100-seed weight, head diameter and oleic acid. Singh and Labana [5] also reported that head diameter had the maximum direct effect on seed yield followed by seed size, days to maturity and plant height. Ahmad et al. [6] observed that days to physiological maturity, plant height and oil content had stronger direct effects on seed yield. They further identified that head diameter, 100-achene weight and achenes/head were important for yield improvement.

Chervet and Vear [7] observed that seed number per capitulum were more important than 1000-seed weight for yield. Rao [3] observed that harvest index showed greatest positive direct effects on achene yield. Plant height, linoleic, linolenic and palmitic acids had direct negative effects on oil yield. Head diameter also showed indirect positive effect on oil yield through oil content. Linoleic acid exhibited high indirect positive affect on oil yield through stem thickness, palmitic and linolenic acids. It may be concluded from this study that oil content, 100-seed weight, head diameter, linoleic acid, oleic acid and stem rot resistance are the most important components determining oil yield. Hence, these traits need to be given high priority for the development of high oil yielding hybrids in sunflower.

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