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INVESTIGATION OF CORRELATION BETWEEN TRAITS AND PATH ANALYSIS OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) GENOTYPES

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ABSTRACT

This study was carried out to determine the correlation between agronomic traits and seed yield of sunflower hybrids and also to determine the direct and indirect effects of analysed traits on seed yield. Correlation studies revealed that days to 50 % flowering, plant height, head diameter, volume weight, seed yield per plant and oil content were important selection indices for both oil and seed yield improvement. Alternaria leaf spot severity had negative and significant correlation on seed yield per plant, oil content and oil yield per plant. This indicated the importance of resistance breeding for Alternaria leaf spot disease. The path analysis revealed that traits namely; days to 50 % flowering, head diameter, oil content, plant height and Alternaria leaf spot severity were important selection indices. Though the correlation analysis showed that 100-seed weight and volume weight were important, the path analysis indicated that these traits were less important.

Keywords: correlation coefficient; path analysis; sunflower.

INTRODUCTION

The genus name *Helianthus* is derived from Greek word "Helios" means sun and "anthos" means flower. The genus *Helianthus* comprises of both annual and perennial herbaceous species. It is successfully grown over a widely scattered geographical area and considered as a crop adapted to a wide range of environmental conditions (Ekin *et al.,* 2005). Sunflower holds great promise because of its short duration, photo-insensitivity and wider adaptability and drought tolerance. Its adaptability to a wide range of soil and climatic conditions, which makes its cultivation possible during any part of the year in the tropical and sub-tropical regions of the country (Reddy and Kumar, 1996). It is a rich source of edible oil (40 to 45 *per cent*) and is considered as good from health point of view due to high concentration of Poly Unsaturated Fatty Acids (PUFA) (55 to 60 *per cent* linoleic acid and 25-30 *per cent* oleic acid) which are known to reduce the risk of coronary diseases by regulating the cholesterol content in blood plasma (Mallik *et al.,* 2020).

The primary objectives of any plant breeder include selection from a natural population or from a developed population to increase yield. Yield is a complex character and is a function of several component characters and their interaction with environment (Mallik *et al.,* 2016). In biological sciences, one usually encounters a group of yield and yield component variables which are correlated due to complex interactions that are uncontrolled and obscured (Wright, 1921). Seed yield is the multiplicative interaction of its components among themselves. The estimates of character association alone do not provide a clear cut picture of cause and effect of characters on yield. Hence, selection based only on correlation is of little use while applying selection on a particular character to increase yield.

Knowledge on association among components of economically important traits can help in providing the information for efficient selection. Although the nature and degree of association among various characters can be estimated by correlation analysis, determining the direct influence of one character on another along each separate path or indirectly via others is worthwhile. In the integrated structure of plant, path coefficient analysis measures the direct influences of one variable upon another and permits the separation of correlation coefficients into components of direct and indirect effects (Wright, 1921). A path coefficient analysis is simply a standardized partial regression coefficient into the measures of direct and indirect effects of each component to the yield (Dewey and Lu, 1959). By knowing the relative importance of each component, selection procedure may be exercised in an unbiased manner for yield improvement.

MATERIALS AND METHODS

The seed material of 115 genotypes for the field experiments were obtained from the Sunflower Unit at the Department of Oilseeds, Tamil Nadu Agricultural University (TNAU), Coimbatore (Table 1). The field experiments were carried out at Department of Oilseeds, TNAU, Coimbatore during

Table 1. List of genotypes used in the research

Sl. No.	Genotypes	Sl.No	Genotypes	Sl.No.	Genotypes
1	17B	40	CSFI 5152	79	CSFI 5398
2	1B	41	CSFI 5177	80	CSFI 5401
3	207 DS B	42	CSFI 5181	81	CSFI 5406
4	207B	43	CSFI 5190	82	CSFI 5411
5	234B	44	CSFI 5194	83	CSFI 8002
6	300B	45	CSFI 5205	84	CSFI 99
7	400B	46	CSFI 5210	85	IR 3
8	607B	47	CSFI 5213	86	M 1014-1
9	60B	48	CSFI 5216	87	M 1014-3
10	821B	49	CSFI 5219	88	M 1014-4
11	850B	50	CSFI 5223	89	POP 440-1-2-1
12	852B	51	CSFI 5232	90	POP 448-3-1-2
13	86B	52	CSFI 5246	91	POP 449-1-2-1
14	ARM 243B	53	CSFI 5254	92	POP 449-1-2-2
15	CO 4	54	CSFI 5260	93	POP 449-1-2-3
16	COSF 1B	55	CSFI 5276	94	POP 449-1-2-4
17	COSF 2B	56	CSFI 5286	95	POP 449-2-1-1
18	COSF 3B	57	CSFI 5287	96	POP 449-2-1-2
19	COSF 5B	58	CSFI 5288	97	POP 449-2-1-3
20	COSF 6B	59	CSFI 5291	98	POP 449-2-1-4
21	COSF 7B	60	CSFI 5292	99	CSFI 13021
22	COSFV 5	61	CSFI 5293	100	CSFI 13022
23	CSFI 5019	62	CSFI 5298	101	CSFI 13023
24	CSFI 5021	63	CSFI 5307	102	CSFI 13069
25	CSFI 5040	64	CSFI 5330	103	CSFI 13071
26	CSFI 5055	65	CSFI 5331	104	CSFI 13024
27	CSFI 5062	66	CSFI 5334	105	CSFI 13028
28	CSFI 5075	67	CSFI 5335	106	CSFI 13033
29	CSFI 5078	68	CSFI 5336	107	CSFI 13034
30	CSFI 5082	69	CSFI 5341	108	CSFI 13035
31	CSFI 5083	70	CSFI 5347	109	CSFI 13043
32	CSFI 5084	71	CSFI 5373	110	CSFI 13001
33	CSFI 5086	72	CSFI 5377	111	CSFI 13002
34	CSFI 5090	73	CSFI 5381	112	CSFI 13003
35	CSFI 5092	74	CSFI 5387	113	CSFI 13004
36	CSFI 5124	75	CSFI 5388	114	CSFI 13005
37	CSFI 5125	76	CSFI 5389	115	TNHSF 239-68-1-1-1
38	CSFI 5133	77	CSFI 5390		
39	CSFI 5140	78	CSFI 5393		

kharif, 2014. The trial was conducted with two replications in a randomized block design. In each replication, each entry was raised in 4m row, adopting a spacing of 60 cm between the rows and 30 cm between the plants. Normal agronomic practices were followed under irrigated condition.

Data recorded on randomly chosen five plants for nine characters viz., days to 50% flowering, plant height (cm), head diameter (cm), 100-seed weight (g), volume weight (g/100 ml), seed yield per plant (g), oil content (%), oil yield per plant (g) and *Alternaria* leaf spot severity. Phenotypic and genotypic associations were computed as per Weber and Moorthy (1952). Path coefficient analysis was carried out as suggested by Wright (1921) and illustrated by Dewey and Lu (1959). Path coefficient analysis (Dewey and Lu, 1959) was utilized to partition the genotype correlation coefficients into measures of direct and indirect effects.

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences among the genotypes for all the characters (Table 2).

Association analysis

Simple correlation and path analysis play significant role to study the inter relationship and relative contribution of each character for crop improvement. The nature and extent of association that existed between the oil yield and other yield component characters and also the association among the yield components were studied through correlation and path analysis. The association of oil yield and yield components in the genotypes were discussed below.

Table 2. Analysis of variance for various characters

Source	Df	Days to 50% flowering (days)	Plant height (cm)	Head diameter (cm)	Alternaria leaf spot (%)	100- seed weight (g)	Volume weight(g/ 100ml)	Seed yield per plant (g)	Oil content (%)	Oil yield per plant (g)
Treatment	114	41.38 **	868.69 **	9.26 **	206.77 **	2.06**	35.42 **	226.89**	11.53**	38.63**
Error	114	4.53	104.00	3.26	49.64	0.41	8.86	28.16	2.90	4.92

** significance at 1 per cent

Table3. Genotypic correlation among oil yield per plant and component characters in the sunflower genotypes

Characters	Plant height (cm)	Head diameter (cm)	Alternaria leaf spot(%)	100-seed weight (g)	Volume weight (g/100ml)	Seed yield per plant (g)	Oil content (%)	Oil yield per plant (g)
Days to 50% flowering (days)	0.68**	0.57**	-0.61**	-0.31**	-0.03	0.31**	0.46**	0.33**
Plant height (cm)		0.69**	-0.42**	-0.07	0.10	0.59**	0.39**	0.59**
Head diameter (cm)			-0.59**	0.21*	0.26**	0.79**	0.29**	0.78**
Alternaria leaf spot(%)				-0.16	-0.24**	-0.45**	-0.29**	-0.46**
100-seed weight (g)					0.17	0.13	-0.29**	0.10
Volume weight (g/100ml)						0.26**	0.21*	0.28**
Seed yield per plant (g)							0.48**	0.99**
Oil content (%)								0.55**

*, ** significance at 5 and 1 per cent respectively

Table 4. Path coefficients of yield components on oil yield per plant (g).

Characters	Days to 50% flowering (days)	Plant height (cm)	Head diameter (cm)	Alternaria leaf spot (%)	100-seed weight (g)	Volume weight (g/100ml)	Oil content (%)	Genotypic correlation coefficient with oil yield perplant (g)
Days to 50% flowering (days)	-0.69	0.16	0.47	0.13	0.05	0.00	0.21	0.33**
Plant height (cm)	-0.47	0.23	0.57	0.09	0.01	-0.01	0.18	0.59**
Head diameter (cm)	-0.39	0.16	0.81	0.12	-0.03	-0.03	0.13	0.78**
Alternaria leaf spot (%)	0.42	-0.10	-0.48	-0.21	0.02	0.02	-0.13	-0.46**
100-seed weight (g)	0.22	-0.02	0.17	0.03	-0.15	-0.02	-0.14	0.10
Volume weight (g/100ml)	0.02	0.02	0.21	0.05	-0.03	-0.10	0.10	0.28**
Oil content (%)	-0.32	0.09	0.23	0.06	0.04	-0.02	0.46	0.55**
	Residue	0.39						

Correlation studies

Correlation analysis measures the mutual relationship between various characters (table 3). It is used to determine the component characters on which selection can be done for improvement in yield. Moorthy (2004), Vidhyavathi *et al.,* (2005), Dan *et al.,* (2012b) and Premnath *et al.,* (2014) have reported positive associations of seed yield with various yield components.

In the present study, oil yield perplant had significant and positive correlation with days to 50 % flowering, plant height, head diameter, volume weight, seed yield per plant and oil content (Kumar *et al.,* 2003; Sridhar *et al.,* 2005; Vidhyavathi*et al.,* 2005; Ravi *et al.,* 2006 and Sowmya*et al.,* 2010; Dan *et al.,* 2012; and Premnath*et al.,* 2014). Days to 50 % flowering had positive and significant association with plant height, head diameter, seed yield per plant, oil content and oil yield but significant and negative correlation with 100 seed weight and *Alternaria*leaf spot. These results are confirmed with the earlier findings of Habibulla *et al.,* (2007), Arshad *et al.,* (2010), Rao *et al.,* (2012) and Dan *et al.,* (2012).

Seed yield per plant had significant and positive correlation with days to 50 % flowering, plant height, head diameter, 100-seed weight, volume weight, oil content and oil yield. Considering the inter relationship, differential association was observed among the yield component characters. Plant height had positive and significant correlation with days to 50 % flowering, head diameter, seed yield per plant, oil content and oil yield per plant. Similar results were reported by Chikkadevaiah *et al.,* (2002), Vidhyavathi *et al.,* (2005) and Ravi *et al.,* (2006), Dan *et al.,* (2012) and Hassan *et al.,* (2013). Head diameter had positive and significant correlation with days to 50% flowering, plant height, 100-seed weight, volume weight, seed yield per plant, oil content and oil yield (Vidhyavathi *et al.,* 2005; Anandhan *et al.,* 2010; Rao *et al.,* 2012 and Dan *et al.,* 2012). Alternaria leaf spot severity showed negative and significant correlation with all traits except 100-seed weight. This indicated the importance of resistance breeding for *Alternaria* leaf spot disease. The trait 100-seed weight showed negative and significant correlation with oil content (Teklewold *et al.,* 2000).

Volume weight had positive and significant correlation with days to 50 % flowering, plant height, head diameter, 100-seed weight, volume weight, seed yield per plant, oil content and oil yield per plant weight (Chikkadevaiah *et al.,* 2002; Moorthy, 2004; Manivannan *et al.,* 2005; Anandhan*et al.,* 2010 and Dan *et al.,* 2012). Seed yield per plant had positive and significant correlation with days to 50 % flowering, plant height, head diameter, 100-seed weight, volume weight, oil content and oil yield per plant weight (Sivamurugan, 2011; Attia*et al.,* 2012; Dan *et al.,* 2012; Neelima *et al.,* 2012 and Kang and Ahmad, 2014). Oil content had positive and significant correlation with days to 50 % flowering, plant height, head diameter, volume weight, seed yield per plant, oil content and oil yield per plant weight as reported by Arshad *et al.,* (2010), Dan *et al.,* (2012) and Kang and Ahmad (2014). But it showed negative and significant correlation with100 seed weight as reported by Teklewold *et al.,* (2000).

Path analysis

Path coefficient analysis permits the separation of direct and indirect effects by partitioning the simple correlation coefficients. It provides a clear picture of the characters that can be relied upon in a selection programme for improvement. In the present study the residual effect was 0.39 which indicated that the chosen characters for the path analysis were appropriate (table 4). The genotypic correlation coefficients of oil yield per plant with other traits were further partitioned into direct and indirect effects and the results are presented in Table 4. Among the traits head diameter and oil content recorded high positive direct effect on oil yield as reported by Nehru and Manjunath, 2003; Mijic *et al.,* 2009 and Dan *et al.,* 2012. Days to 50 % flowering expressed high negative effect on oil yield per plant (Habibullah *et al.,* 2007 and Neelima *et al.,* 2012). Plant height recorded moderate and positive direct effects (Lakshminarayana *et al.,* 2004 and Moorthy *et al.,* 2004).

*Alternaria*leaf spot recorded moderate negative direct effects on oil yield whereas 100 seed weight and volume weight expressed low negative direct effect on oil yield. With regard to indirect effects, days to 50 % flowering recorded high positive indirect effect *via* head diameter. Same trend was reported by Habibullah *et al.,* (2007) and Sowmya *et al.,* (2010). Plant height showed high positive indirect effect *via* head diameter but high negative indirect effect *via* days to 50 % flowering as reported by Tahir *et al.,* (2002) and Habibullah *et al.,* (2007).

Alternaria leaf spot recorded high negative indirect effect *via* head diameter (Patil *et al.,* 2011). 100-seed weight recorded moderate and positive indirect effect *via* days to 50 % flowering. Volume weight recorded moderate positive indirect effect *via* head diameter (Patil *et al.,* 2011). The oil content expressed high negative indirect effect *via* 100-seed weight recorded moderate and positive indirect effect *via* days to 50 % *per cent* flowering.

CONCLUSION

From the foregoing discussion on character analysis, it may be concluded that the traits *viz*., days to 50 % flowering, plant height, head diameter, volume weight, seed yield per plant and oil content were important selection indices for both oil and seed yield improvement. *Alternaria* leaf spot severity had negative and significant correlation on seed yield per plant, oil content and oil yield per plant. This indicated the importance of resistance breeding for *Alternaria* leaf spot disease.

The path analysis revealed that traits namely; days to 50 % flowering, head diameter, oil content, plant height and *Alternaria* leaf spot severity were important selection indices. Though the correlation analysis showed that 100-

seed weight and volume weight were important, the path analysis indicated that these traits were less important.

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