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Research Notes

Character association and path analysis in sunflower

ASISH K. BINODH, N.MANIVANNAN AND P. VINDHYA VARMAN
Department of Oil Seeds, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore – 641 003.

The efficiency of selection mainly depends on the direction and magnitude of association between yield and its components. Knowledge on the strength and type of association is an important pre-requisite for the formulation of breeding procedure (Breese and Haywards, 1972). Hence correlation and path analysis are necessary for efficient genetic improvement. The value of correlation between yield and yield traits gives the net effect of the relationship seen between two characters. The inter dependence of these characters will influence seed yield either directly or indirectly and as a result the information obtained on the association in these traits become unreliable. Therefore path coefficient analysis permits the separation of the direct effects from the indirect effects through other related characters by partitioning the genotypic correlation coefficients, providing a clear picture of the characters that can be relied upon in a selection programme for improvement of yield. Sunflower is rather a new crop for India where it came under cultivation only in early seventies gained importance in recent years due to its economic values. Considering the above points, the present study aimed to determine association between characters and cause effects of different characters on seed yield for twenty four genotypes in sunflower.

The material consisted of twenty four genotypes were raised to evaluate the performance for important characters in sunflower. The experiment was laid out in a randomized block design with two replications during r*abi* / summer 2005-2006 at Department of Oilseeds, Center for Plant Breeding and Genetics, TNAU, Coimbatore. Each genotype was sown in two rows of 6m length with a spacing of 60 x 45 cm. The data were recorded on five random plants from each genotype in each replication for eight characters *viz.*, days to fifty per cent flowering, plant height, head diameter, volume weight, hundred seed weight, oil content, seed yield per plant and oil yield per plant. Oil content in the seeds of selected plants was determined with the help of Oxford 4000 Nuclear Magnetic Resonance (NMR) Spectrometer available at Department of Oilseeds, TNAU and expressed in percent. Oil yield per plant was calculated as per cent ratio of seed yield per plant (g) multiplied with oil content (%) gives oil yield per plant. The data were subjected to analysis of variance (Panse and Sukhatme, 1989). Correlation coefficient and path analysis were carried out as per Goulden (1952) and Dewey and Lu (1959) respectively. The direct and indirect effects were classified based on Scale (Lenka and Mishra, 1973).

Genotypic correlation co-efficient for eight characters in sunflower are presented (Table 1). Seed yield per plant showed highly significant positive association with oil yield. Eventhough the characters hundred seed weight, head diameter and oil content had positive correlation with seed yield per plant,. they were non-significant. Plant height and days

Table 1. Genotypic correlation coefficients between yield and component characters in sunflower.

Characters	Days to 50 per cent flowering	Plant height (cm)	Head diameter (cm)	Volume weight (g)	Hundred seed weight (g)	Oil Content (%)	Oil Yield (g)
Plant height (cm)	0.2128						
Head diameter (cm)	-0.2554	0.4207*					
Volume weight (g)	-0.3009	0.4138*	0.8135**				
Hundred seed weight (g)	-0.1183	0.0603	0.3084	0.2795			
Oil content (%)	-0.3778	-0.3796	-0.169	-0.1844	0.3304		
Oil Yield (g)	-0.4207*	0.3069	0.7593**	0.7513**	0.3895	0.028	
Seed yield (g)	-0.4316*	-0.1096	0.1196	-0.1136	0.1415	0.170	0.465**

* Significant at 5% level, ** Significant at 1% level

Table 2. Path coefficients of yield components on seed yield per plant in sunflower

Characters	Days to 50 per cent flowering	Plant height (cm)	Head diameter (cm)	Volume weight (g)	Hundred seed weight (g)	Oil Content (%)	Oil Yield (g)	Genotypic Correlation co-efficients
Days to 50 percent flowering	-0.3694	-0.0019	-0.0254	0.3628	-0.0043	0.0839	-0.4774	-0.4316*
Plant height (cm)	-0.0786	-0.0087	0.0418	-0.4989	0.0022	0.0843	0.3483	-0.1096
Head diameter (cm)	0.0944	-0.0037	0.0994	-0.9808	0.0111	0.0376	0.8617	0.1196
Volume weight (g)	0.1112	-0.0036	0.0809	-1.2056	0.0101	0.041	0.8526	-0.1136
Hundred seed weight (g)	0.0437	-0.0005	0.0307	-0.337	0.0361	-0.0734	0.4419	0.1415
Oil content (%)	0.1396	0.0033	-0.0168	0.2224	0.0119	-0.2222	0.0318	0.170
Oil Yield (g)	-0.1554	-0.0027	0.0755	-0.9058	0.014	--0.0062	1.1348	0.465**

* Significant at 5% level, ** Significant at 1% level

to fifty per cent flowering had negative association with seed yield per plant. This is in accordance with research findings of Sreedhar (1989). Regarding the correlation between the component traits, the following associations were observed for yield traits. Head diameter showed highly significant positive association with volume weight and oil yield. Plant height had significant positive correlation with head diameter and volume weight. Days to fifty per cent flowering showed significant negative association with oil yield. Significant positive correlation was observed between oil yield and volume weight. The correlation studies revealed that the positive association of seed yield per plant with oil yield besides the negative association of days to fifty per cent flowering with seed yield per plant.

Simple correlations many times do not give a clear picture of the association between different traits of a crop species. For this, one should go for path coefficient analysis which is based on cause effect relationship. Path coefficient analysis permits the separation of the direct effects from the indirect effects through other related characters by partitioning the genotypic correlation coefficients, providing a clear picture of the characters that can be relied upon in a selection programme for improvement of yield

The direct and indirect effects of various characters on seed yield per plant are tabulated (Table 2). Oil yield recorded very high positive direct effect on seed yield per plant. Negligible positive direct effect on seed yield was shown by head diameter and hundred seed weight. However, very high negative direct effect was exhibited by volume weight. Days to fifty per cent flowering and oil content recorded high and moderate negative direct effect on seed yield per plant respectively. Similar results of negative direct effect of oil content on seed yield per plant was already reported (Rao, 1987; Lakshminarayana *et al.,* 2004). The characters plant height, head diameter, volume weight and hundred seed weight influences the seed yield per plant through high positive indirect effect of oil yield and days to fifty per cent flowering through oil content.

The present investigation revealed that oil yield had significant positive genotypic correlation with seed yield per plant, besides the contribution of direct, indirect effect *via* other characters. Thus, these traits can be relied upon for selection in a breeding programme for yield improvement. From the present study, it could be concluded that the seed yield could be improved through selection for oil yield, plant height, hundred seed weight and oil content and these attributes could be utilized for selection in breeding programme.

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Studies on Inheritance of Some Qualitative Characters in Bread Wheat *(Triticum aestivum* L. (Em.) Thell.)

R.K.KAMBOJ
SKN College of Agriculture, Jobner, (Jaipur)-303329

Wheat is an important food grain crop of India. In wheat plant height and plant colour are the two important characteristics. The productiveness of semi-dwarf varieties of wheat had stimulated interest towards the development of short statured varieties. Therefore, significant increase in yield of wheat were made possible due to dwarfing genes. Dwarf, semi-dwarf and tall plants are observed in wheat. Similarily, salt resistant cultivars of wheat are invariably hexaploid, tall, awned, red grained, prone to lodging, highly susceptible to diseases and leaves with distinct light green colour (Rana, 1986). However, dark green plant colour is also observed. A study of inheritance of plant height and plant colour will help to strengthen a sound breeding programme and better evalution of segregating population for these characteristics. Few studies have been conducted on the genetics of plant height in wheat. Inheritance pattern of the genes for plant height has been summarized by Ram and Singh (1998). Nieves (1937) reported tallness to be dominant over dwarf ness and controlled by two independent gene pairs. Torrie(1936) , Kuspira and Unrau (1957) , Allan and Vogel (1963) and Kamboj(2003) reported plant height to be controlled by multiple genes and tallness to be partially dominant. Reddy and Heyne(1970) reported a good agreement for a two factor difference.

The material consisted of four genotypes *viz.,* Kh65, HD4530, WS-5 and Job 89, Two crosses *viz.,* HD4530 x Kh 65 and WS-5 x Kh 65 were made between Kh65, a tall wheat cultivar and HD 4530 a semi dwarf and WS-5 a dwarf cultivar. Similarity the two crosses, *viz.,* WS-5 x Kh65 and Job 89 x Kh 65 were made between Kh