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Study of Character Association and Path Analysis in Newly Developed Single Crosses of Maize (*Zea mays* L.)

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Abstract:

The present investigation was carried out to study the correlation and path analysis in eight parents and their 28 F_1's and two commercial check hybrids, namely, Vivek hybrid-9 and SM-3. Correlation coefficient of different characters showed that the traits ear length, ear girth, kernel rows per ear and 1000 kernel weight had significant association with grain yield as well as among themselves. So selection should be exercised considering these characters in breeding programme. Path analysis showed that high direct effect was exhibited by 1000 kernel weight, whereas moderate positive direct effect was recorded by kernel row per ear and ear girth on grain yield. Hence, selection for these traits could bring improvement in the yield and yield components. The low residual effect indicated that the characters studied in the present investigation explained almost all the variability towards yield.

Key words*:* Correlation, Path analysis, Maize, Single cross, Yield.

Introduction

Maize (*Zea mays* L) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. It is a diploid (2n=20), cross-pollinated, monocot plant and belongs to the tribe Maydeae of the grass family Poacea. During 2014-15 the total cultivated area of maize in world was 179.69 million hectares and the total world production was reported to be 1,015.06 million metric tons. In India it was cultivated on the total area of 9.19 million hectares with total production of 24.17 million metric tons (USDA, January 2017). The basic objective of the plant breeders would always be towards yield improvement. Yield is polygenetically controlled and associated with number of related traits. Hence understanding the relationship between yield and its components is of paramount importance for making the best use of these relationships in selection. The direct selection for yield is not sufficiently effective. Therefore, indirect selection is desirable for improvement of yield (Mahapatra 2013). The correlation alone does not provide information on the direct and indirect contribution of component characters, which necessitates the study of cause and effect relationship of different characters by partitioning

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into direct and indirect effects by path coefficient analysis that depicts the exact relationship of characters. Therefore, present investigation was carried out considering 28 F_1's, 08 parents and 02 checks to understand the association and path analysis of component characters with respect to important yield related traits.

Materials And Methods

The present investigation was undertaken during *kharif* 2012 at TCA, Dholi farm of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar. Dholi farm has subtropical humid climate characterized by hot summer, moderate to heavy rainfall and cold winter. The experimental area was of uniform topography, fertile and well drained soil. The experimental materials comprised of 8 inbred lines of quality protein maize procured from AICRP on maize, T C A, Dholi. These lines were POP-147, POP-147-F_2-102-2-1-B-2-B-B-B, POP-65, POP-27, CML-163, P-502, HKI-1105, Dholi-inbred-10. During the *rabi* season 2011-12, the eight inbred lines of maize were grown in the crossing block at plant to plant spacing of 20 cm and row to row spacing of 75 cm in four row plot, on two sowing dates. The inbred lines were crossed in all possible cross combinations without reciprocal. Crosses and parents were harvested separately. The evaluation trial was conducted in *kharif* season 2012 with 28 F_1's, 08 parents and 02 checks (Vivek hybrid-9 and SM-3) in complete randomized block design with three replications. Each plot consisted of two rows of four meter length with row to row spacing of 75 cm and plant to plant spacing of 20 cm, within row. The recommended packages of practices were used for raising a good and healthy crop. Ten competitive plants were randomly taken from each plot in each replication for recording data of the traits, namely, plant height, ear height, ear length, ear girth, number of kernel rows per ear and grain yield. The traits, days to 50 per cent silk and days to 50 per cent tasseling were recorded on plot basis. The correlation coefficients of yield with various quantitative characters were partitioned into measure of direct and indirect effect with the help of path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

Results And Discussions

The genetic correlation coefficients indicate the higher magnitude for the traits in comparison to phenotypic correlation coefficient. It indicated major role of genotypic variance in the expression of the traits (Table 1).The same results were observed by Verma *et al*. (1992) for most of the traits. Therefore, only phenotypic correlations are discussed.

Yield is an ultimate complex product which is influenced by several interdependent quantitative traits. Selection for yield *per se* may not be effective as it is highly influenced by environmental deviations. Therefore, selection for yield components influencing directly or indirectly to yield but are less influenced by the environment may be taken into consideration. When selection is exercised for improvement of any character highly associated with the end products, it simultaneously affects a number of other correlated characters. Plant height exhibited highly significant and positive correlation with ear height, length, girth, 1000-kernel weight and grain yield. The present significant and positive correlation between grain

yield and plant height is supported by the findings of Gautam *et al*. (1999), Bello *et al*. (2010), and Zarei *et al*.(2012). Ear height showed highly significant and positive correlation with ear length, girth, 1000- kernel weight and grain yield. The similar findings between grain yield and ear height were also observed by Kumar *et al.* (2006), Hemavathy *et al*. (2008) and Zarei *et al*.(2012). Ear length showed highly significant and positive correlation with ear girth, number of kernel rows per ear, 1000- kernel weight and grain yield. The significant and positive correlation between grain yield and ear length was also recorded by Yadav *et al*. (2003) and Kumar *et al*. (2006). Ear girth exhibited highly significant and positive correlation with 1000 – kernel weight and grain yield. Its correlation with number of kernel rows per ear was also significant and positive. The significant and positive correlation between grain yield and ear girth was also observed by Yadav *et al*. (2003). Number of kernel rows per ear showed highly significant and positive correlation with 1000- kernel weight and its correlation with grain yield was significant and positive. the significant and positive correlation between grain yield and number of kernel rows per ear was also recorded by Yadav *et al*. (2003), Kumar *et al.* (2006), Hemavathy *et al*. (2008) and Beiragi *et al*. (2011). 1000-kernel weight had highly significant and positive correlation with grain yield. the significant and positive correlation between grain yield and 1000- grain weight was observed by Saha and Mukherjee (1993), Kumar *et al.* (2006), Hossain *et al*. (2007), Zhang *et al*. (2007) and Hemavathy *et al*. (2008). Days to 50% tasseling showed significant and negative correlation with grain yield and days to 50% silking showed significant and negative correlation with ear length and grain yield. The significant and negative correlation between grain yield and days to 50% silk was reported by Hossain *et al.* (2007). This suggests that the early tasseling and silking will be preferred in breeding programme. The traits ear length, ear girth, kernel rows per ear and 1000 kernel weight had significant association with grain yield as well as among themselves. So selection should be exercised considering these characters in breeding programme.

The simple correlation alone however, is not a true reflection of the nature of association of the related traits with each other when other characters are held constant. Path analysis enables breeder to understand whether the association of causal variable with resultant variable is due to direct effect or is a consequence of their indirect effect via some other traits. The estimates of path coefficient analysis are furnished for yield and yield component characters (Table 2). In this investigation, high direct effect was exhibited by 1000 kernel weight, whereas moderate positive direct effect was recorded by kernel row per ear and ear girth on grain yield. Correlation coefficient of these characters (1000 kernel weight, kernel rows per ear and ear girth) was also high and in the same direction with grain yield indicating their true relationship with grain yield. So these traits may be directly subjected for improvement in maize breeding programme. The maximum positive and direct effects of 1000- kernel weight and ear girth were

supported by the findings of Saha and Mukherjee (1993). However, strong positive and direct effect of 1000- grain weight was supported by Kumar *et al*. (2006). The direct effect of ear girth and number of kernel rows per ear was supported by Debnath and Khan (1991) and Kumar *et al*. (2006). All traits viz., chlorophyll content, ear girth, kernel rows per ear, ear length, plant height, ear height, days to 50 per cent silking and days to 50 per cent tasseling exhibited high indirect effect through 1000 kernel weight on grain yield. Thus, it implicated from above discussion that the trait 1000 kernel weight have to be given importance in selection process along with ear girth and kernel row per ear for improvement in yield, since they had positive correlation with grain yield, positive inter correlation among themselves, moderate to high direct effect towards grain yield. The positive indirect effects of ear girth, ear length, plant height, ear height and number of kernel rows per ear via 1000-kernel weight were also supported by Saha and Mukherjee (1993) and Sood *et al*. (2006). Hence, selection for these traits could bring improvement in the yield and yield components. The residual effect for grain yield was 0.3244 which indicated that the ten characters studied accounted for 67.56 per cent variability and 32.44 per cent of variability in yield was due to unknown factors.

Table1: Phenotypic correlation coefficient between pairs of quantitative characters in newly developed single crosses of maize

Character		Days to 50% silking	Plant height (cm)	Ear height (cm)	Chlorophyll content	Ear length(cm)	Ear girth(cm)	Kernel rows/ ear	1000 Kernel weight.	Grain yield (Kg|ha)
Days to 50% tasseling	**P**	0.830**	-0.493**	-0.431**	-0.357**	-0.249**	-0.481**	-0.429**	-0.536**	**-0.555****
	G	1.047	-0.559	-0.514	-0.499	-0.436	-0.635	-0.521	-0.588	**-0.626**
Days to 50% silking	P		-0.429**	-0.386**	-0.407**	-0.210*	-0.472**	-0.433**	-0.522**	**-0.539****
	G		-0.533	-0.482	-0.565	-0.414	-0.649	-0.57	-0.627	-0.661
Plant height (cm)	P			0.890**	0.370**	0.326**	0.497**	0.524**	0.563**	**0.581****
	G			1.014	0.544	0.469	0.683	0.618	0.625	0.629
Ear height (cm)	P				0.294**	0.304**	0.432**	0.461**	0.502**	**0.509****
	G				0.471	0.461	0.619	0.565	0.571	0.57
Chlorophyll content	P					0.336**	0.641**	0.628**	0.703**	**0.640****
	G					0.534	0.864	0.925	0.956	0.891
Ear length (cm)	P						0.510**	0.431**	0.417**	**0.435****
	G						0.92	0.624	0.671	0.682
Ear girth (cm)	P							0.645**	0.696**	**0.720****
	G							0.907	0.899	0.916
Kernel rows/ Ear	P								0.824**	**0.819****
	G								0.953	0.934
1000 Kernel weight	P									**0.934****
	G									0.987

**: Significant at 1% level of significance.

Table 2. Direct (diagonal) and indirect phenotypic effect of different characters towards grain yield in newly developed single crosses of maize

SNo	Character	Days to 50% tesseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Chloro phyll content	Ear length(cm)	Ear girth(cm)	Kernel rows/ ear	1000 Kernel weight
1	Days to 50% tasseling	**-0.018**	-0.015	0.009	0.008	0.007	0.005	0.009	0.008	0.010
2	Days to 50% silking	-0.031	**-0.037**	0.016	0.014	0.015	0.008	0.018	0.016	0.020
3	Plant height (cm)	-0.039	-0.034	**0.080**	0.071	0.030	0.026	0.040	0.042	0.045
4	Ear height (cm)	0.022	0.020	-0.046	**-0.052**	-0.015	-0.016	-0.022	-0.024	-0.026
5	Chlorophyll content	0.031	0.035	-0.032	-0.025	**-0.086**	-0.029	-0.055	-0.054	-0.061
6	Ear length(cm)	-0.003	-0.002	0.004	0.003	0.004	**0.011**	0.006	0.005	0.005
7	Ear girth(cm)	-0.057	-0.056	0.059	0.051	0.076	0.061	**0.119**	0.076	0.082
8	Kernel rows/ ear	-0.055	-0.055	0.067	0.059	0.080	0.055	0.082	**0.127**	0.105
9	1000 kernel weight	-0.405	-0.394	0.425	0.379	0.531	0.315	0.525	0.622	**0.755**
10	**Grain Yield (kg/ha)**	**-0.555****	**-0.539****	**0.581****	**0.509****	**0.640****	**0.435****	**0.720****	**0.819****	**0.934****

**: Significant at 1% level of significance. Residual effect= 0.3244

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