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Original Research Paper

Elucidation of Variability, Interrelationships and Path-coefficient in Maize (*Zea mays* L.)

Anand Chaudhary, Kartikeya Srivastava, Vishal Agrawal and Santosh Kumar†
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005, India
†Corresponding author: Santosh Kumar

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ABSTRACT

In order to study the genetic variability, heritability with genetic advance and character association along with the partitioning of the association into direct and indirect effects in 40 inbreds, an experiment was conducted at the Agricultural Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.), India during *rabi* season of 2011-12. Almost all the characters under study showed highly significant variation. Higher values of genotypic and phenotypic coefficients of variation were observed for the characters like grain yield per plant, number of kernels per row and ear height. Among the characters under study, yield per plant, ear height, number of kernels per row and 100-grain weight showed high heritability coupled with high genetic advance suggesting their importance for direct selection. Correlation studies revealed that number of kernels per row followed by cob diameter, ear height and number of kernel rows per cob exhibited significant positive association with grain yield per plant. Days to 50% tasseling and days to 50% silking showed a negative association with yield. Highest direct positive effect on yield per plant was observed for number of kernels per row followed by a number of kernel rows per cob.

INTRODUCTION

Maize *(Zea mays* L.) is the third most important cereal crop in India after rice and wheat. It belongs to the tribe Maydeae, of the grass family, Poaceae. India is the fifth largest producer of the maize after USA, China, Brazil and Argentina. The annual production, productivity and acreage of maize in India is 20.5 mt, 2.4 t/ha and 8.6 mha, respectively. The suitability of maize to diverse environment is unmatched by any other crop as it has a wide range of adaptability. The present emphasis on the development of single cross hybrids is likely to ensure higher growth rates in productivity of this versatile crop in the years to come. The presence of genetic variability is the pre-requisite for a successful hybrid development program in maize and constitution of the breeding population. Assessment of genetic variability in the existing populations assumes prime importance in this context. Study of variability, heritability, genetic advance, and character association in the germplasm will help to ascertain the real potential of the genotype.

Efficiency of selection in any breeding programme mainly depends upon the knowledge of association of the characters. Progress in any breeding programme depends upon the magnitude of useful variability present in the population and the extent to which the desirable characters are heritable. In order to formulate selection indices for genetic improvement of yield, the cause and effect relationship of the trait is very essential and is done by path analysis. The correlation coefficient indicates an association between two characters, is useful as a basis for indirect selection for further improvement. Keeping these points in view, the present study was planned and executed with the objectives of studying the genetic variability, heritability, genetic advance and study of character association along with the partitioning of their association into direct and indirect effects in 40 inbreds.

MATERIALS AND METHODS

The present experiment was carried out at the Agricultural Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.). The soil type of experimental site is fertile, alluvial loam which is the characteristics of Indo-Gangetic plains. The experimental materials consisted of 40 genotypes of maize (*Zea mays* L.) obtained from the All India Co-ordinated Maize Improvement Project, Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The experiment was laid out in randomized block design with three replications. Each entry was sown with a single row of 3 m length with row to row spacing of 60 cm and plant to plant spacing of 20 cm. Initially two seeds per hill were planted and later on one plant was thinned to maintain single plant per hill. Two boarder rows were also planted to avoid the boarder effect. The recommended cultural practices were carried out to raise a good crop. The pre and post harvest observations were recorded on five plants selected at random from each genotype in each replication for 12 metric characters *viz.* days to 50% tasseling, days to 50% silking, plant height (cm), ear height (cm), leaf width (cm), tassel length (cm), cob length (cm), cob diameter (cm), number of kernel rows per cob, number of kernels per row, 100-grain weight (g) and grain yield per plant (g). For estimation of grain yield, ears were harvested at maturity and weighed; the moisture content of the harvested grains were recorded by using an electronic moisture meter (FARMEX) and grain yield per plant was adjusted at 15% moisture and 80% shelling by the formula-

$$Grain\ yield\ per\ plant = \frac{W \times (100 - M) \times 0.8}{85 \times N}$$

Where, W = weight of the dehusked cobs at harvest, M = grain moisture content at harvest and N = no. of cobs weighed.

Mean of the data from the sampled plants of each genotype in respect of different characters was used for various statistical analysis. Data were analysed using statistical analysis software Windostat® V.8.5.

RESULTS AND DISCUSSION

Statistical analysis of data collected revealed highly significant variation for all the traits under study except cob diameter. The results of the various variability parameters viz. mean, range, phenotypic and genotypic coefficients of variation, heritability in broad sense and genetic advance as percent of mean is presented in Table 1. The relatively high values of phenotypic coefficient of variation than their respective genotypic coefficient of variation indicate the involvement of environmental factors in the inheritance of these traits. Characters like grain yield per plant, number of kernels per row, ear height, 100-grain weight and cob length showed comparatively higher values of genotypic coefficient of variation which in turn reveals that direct selection for these traits would be effective and responsive. Similar findings by Gupta & Salgotra (2004), Rafiq et al. (2010), Kumar et al. (2011) and Tengan et al. *(*2012) revealed presence of substantial variability for all traits studied. High heritability estimates for characters like ear height, yield per plant, 100-grain weight and for days to 50% tasseling indicate that the variation observed for these characters are mainly genotypic. Mahmood et al. (2004) and Rafique et al. (2004) also found the highest heritability estimates for grain yield per plant and plant height. Among the traits under study some traits viz., yield per plant, kernel per row, ear height and 100-grain weight had shown higher estimates of genetic advance representing the additive gene action in the inheritance of these traits, thereby selection for these traits will be highly responsive. Similar results have been reported in maize by Kabdal et al. (2003).

The character association study presented in Table 2 reveals highest significant positive correlation with yield per plant was possessed by number of kernels per row followed by cob diameter, number of kernel rows per cob and ear height, suggesting that indirect selection for high yield through direct selection for these characters will be highly effective. Viola et al. (2003), Tang Hua et al. (2004), Malik et al. (2005), Kumar et al. (2006), Hemavathy et al. (2008), Raghu et al. (2011), Moradi & Azarpour (2011) and Tengan et al. (2012) also observed similar type of results. Flowering traits like days to 50% tasseling and days to 50% silking showed significant negative correlation with grain yield, whereas a positive significant association was observed with plant height and cob length.

Path coefficient analysis for yield per plant (independent trait) and yield contributing traits are presented in Table 3. The study reveals that the major portion of the highly significant positive correlation between yield per plant and number of kernels per row is due to its direct effect only, also it is the highest direct positive effect on yield per plant among all the traits studied. Similar findings were reported earlier by Singh et al. (1998), Rafiq et al. (2010), Raghu et al. (2011) Selvaraj et al. (2011) and Moradi & Azarpour (2011). Number of kernel rows per cob, 100-grain weight, cob diameter, days to 50% tasseling, cob length and ear height also has high direct positive effect on yield per plant. Venugopal et al. (2003) also reported that plant height, ear height, ear length, ear girth, 100-grain weight and number of kernels per row were positively associated with grain yield. Days to 50% silking had highest direct negative effect on grain yield per plant. Perusal of Table 3 also indicates that direct and all the indirect effects of plant height and ear height on yield via all the component traits were positive. The results of path coefficient analysis suggest that the selection for higher number of kernels per row, number of kernel rows per cob, 100-grain weight, cob diameter, plant height and ear height will be highly effective in improving the grain yield per plant in the maize.

CONCLUSION

In maize breeding, presence of a variable germplasm for selection is the deciding factor for the success of the programme. A genetically variable population is a must for the selection of good inbreds to be incorporated in single cross hybrid development in maize. The present study indicated the presence of genetic variability for most of the traits in genotypes under investigation. Character association study

Table 1: Estimates of variability parameters for yield and yield traits in maize.

Characters	Mean ± SEM	Range		PCV (%)	GCV (%)	h^2(bs)(%)	GA as percent of mean
		Minimum	Maximum				
DT	114.904 ± 0.789	101.000	121.667	4.037	3.858	91.30	7.594
DS	115.192 ± 0.875	105.333	122.333	4.018	3.796	89.30	7.389
PH	116.175 ± 2.938	82.333	145.167	12.677	11.896	88.10	22.996
EH	53.628 ± 1.377	33.400	89.000	19.931	19.429	95.00	39.014
LW	8.754 ± 0.226	6.933	10.733	11.293	10.371	84.30	19.619
TL	30.445 ± 0.744	23.167	37.000	10.381	9.479	84.30	17.829
CL	13.226 ± 0.481	9.200	19.250	15.951	14.653	84.40	27.729
CD	3.585 ± 0.109	2.787	4.300	10.407	8.97	74.30	15.926
R/C	12.933 ± 0.454	9.800	16.933	13.712	12.29	80.30	22.692
K/R	18.767 ± 0.946	7.267	32.100	26.175	24.675	88.90	47.917
100-GW	19.425 ± 0.476	14.697	28.360	16.805	16.261	93.60	32.411
GY/P	51.782 ± 2.442	24.537	117.537	32.751	31.717	93.80	63.273

DT-Days to 50% tasseling; DS-Days to 50% silking; pH-Plant height; EH-Ear height; LW-Leaf width; TL-Tassel length; CL-Cob length; CD-Cob diameter; R/C-Number of kernel rows per cob; K/R-Numbers of kernels per row; 100-GW-100-Grain weight; GY/P-Grain yield/Plant.

Table 2: Estimates of phenotypic correlation coefficients among 12 yield attributes of maize.

Traits	DT	DS	pH	EH	LW	TL	CL	CD	R/C	K/R	SI	GY/P
DT	1.000	0.923 **	0.104	0.050	0.027	-0.194	-0.206	-0.216	-0.094	-0.289	-0.346 *	-0.355*
DS		1.000	0.091	0.003	-0.048	-0.144	-0.154	-0.165	-0.136	-0.333 *	-0.187	-0.366*
pH			1.000	0.769**	-0.140	0.097	0.183	0.173	0.104	0.155	0.010	0.352*
EH				1.000	0.126	0.045	0.308	0.252	0.214	0.274	0.066	0.486**
LW					1.000	-0.114	0.059	0.095	0.267	0.096	-0.132	0.067
TL						1.000	0.429**	0.112	-0.004	0.122	0.202	0.280
CL							1.000	0.180	-0.164	0.241	0.191	0.364*
CD								1.000	0.505 **	0.303	0.144	0.556**
R/C									1.000	0.372 *	-0.254	0.486**
K/R										1.000	-0.140	0.730**
SI											1.000	0.155
GY/P												1.000

*P=0.05; **P=0.01

DT-Days to 50% tasseling; DS-Days to 50% silking; pH-Plant height; EH-Ear height; LW-Leaf width; TL-Tassel length; CL-Cob length; CD-Cob diameter; R/C-Number of kernel rows per cob; K/R-Numbers of kernels per row; 100-GW-100-Grain weight; GY/P-Grain yield/Plant.

Table 3: Direct and indirect effect of eleven component characters on grain yield per plant in maize.

Traits	DT	DS	pH	EH	LW	TL	CL	CD	R/C	K/R	100-GW	Correlation coefficient withGY/ P
DT	0.159	0.147	0.017	0.008	0.004	-0.031	-0.033	-0.034	-0.015	-0.046	-0.055	-0.355*
DS	-0.203	-0.220	-0.020	-0.001	0.011	0.032	0.034	0.036	0.030	0.073	0.041	-0.366*
pH	0.008	0.007	0.079	0.061	-0.011	0.008	0.014	0.014	0.008	0.012	0.001	0.352*
EH	0.007	0.001	0.103	0.134	0.017	0.006	0.041	0.034	0.029	0.037	0.009	0.486**
LW	-0.002	0.003	0.008	-0.007	-0.054	0.006	-0.003	-0.005	-0.014	-0.005	0.007	0.067
TL	-0.016	-0.012	0.008	0.004	-0.009	0.082	0.035	0.010	-0.0003	0.010	0.017	0.280
CL	-0.025	-0.019	0.023	0.038	0.007	0.053	0.123	0.022	-0.020	0.030	0.023	0.364*
CD	-0.036	-0.028	0.029	0.042	0.016	0.019	0.030	0.167	0.084	0.051	0.024	0.556**
R/C	-0.024	-0.034	0.026	0.054	0.068	-0.001	-0.042	0.128	0.253	0.094	-0.064	0.486**
K/R	-0.146	-0.169	0.078	0.139	0.049	0.062	0.122	0.153	0.188	0.506	-0.071	0.730**
100-GW	-0.077	-0.042	0.002	0.015	-0.030	0.045	0.043	0.032	-0.057	-0.031	0.223	0.155

Residual Effect = 0.4466; Direct effects are on main diagonal.

*P=0.05; **P=0.01

DT-Days to 50% tasseling; DS-Days to 50% silking; pH-Plant height; EH-Ear height; LW-Leaf width; TL-Tassel length; CL-Cob length; CD-Cob diameter; R/C-Number of kernel rows per cob; K/R-Numbers of kernels per row; 100-GW-100-Grain weight; GY/P-Grain yield/Plant.

and path-coefficient analysis revealed the importance of components characters like number of kernels per row, number of kernel rows per cob, cob diameter and ear height, in improvement of yield as they were found significantly and positively associated with yield. Thus, from the present study it has been concluded that due emphasis should be given on these traits during the selection in maize for improvement of grain yield.

REFERENCES

Gupta, S. P. and Salgotra, R. K. 2004. Variability and correlation studies in *(Zea mays* L.) under intermediate zone of Jammu. Environment and Ecology. 22(Spl-3): 554-557.

Hemavathy, A. T., Balaji, K., Ibrahim, S. M., Anand, G. and Sankar, D. 2008. Genetic variability and correlation studies in maize *(Zea mays* L.). Agricultural Science Digest, 28: 112-114.

Kabdal, M. K., Verma, S. S., Ahmad, N. and Panwar, U. B. S 2003. Genetic variability and correlation studies of yield and its attributing characters in maize *(Zea mays L.).* Agricultural Science Digest, 23: 137-139.

Kumar, S., Shahi, J. P., Singh, J. and Singh, S. P. Correlation and path analysis in early generation inbreds of maize *(Zea mays* L.). Crop Improvement, 33: 156-160.

Mahmood, Z., Malik, S. R., Akhtar, R. and Rafique, T. 2004. Heritability and genetic advance estimates from maize genotypes in Shishi Lusht a valley of Krakurm. International Journal of Agriculture and Biology, 6: 790-791.

Malik, H. N., Malik, S. I., Hussain, M. O. Z. A. M. I. L., Chughtai, S. U. R. and Javed, H. I. 2005. Genetic correlation among various quantitative characters in maize *(Zea mays* L.) hybrids. Journal of Agriculture and Social Sciences, 1: 262-265.

Moradi, M. and Azarpour, E. 2011. Determination of most important part of yield components by path analysis in corn. The Journal of American Science, 7(5): 646-650.

Rafique, Muhammad, Hussain, A., Mahmood, T., Alvi, A. W. and Alvi, M. B. 2004. Heritability and interrelationships among grain yield and yield components in maize. International Journal of Agriculture and Biology, 6: 1113-1114.

Rafiq, C. M., Rafique, M., Hussain, A. and Altaf, M. 2010. Studies on heritability, correlation and path analysis in maize (*Zea mays* L.). Journal of Agricultural Research (Lahore), 48(1): 35-38.

Raghu, B., Suresh, J., Kumar, S. S. and Saidaiah, P. 2011. Character association and path analysis in maize (*Zea mays* L.*).* Madras Agricultural Journal, 98(1/3): 7-9.

Selvaraj, C. I. and Nagarajan, P. 2011. Interrelationship and path-coefficient studies for qualitative traits, grain yield and other yield attributes among maize (*Zea mays* L.). International Journal of Plant Breeding and Genetics, 5(3): 209-223.

Singh, A. K., Shai, J. P., Singh, J. K. and Singh, R. N. 1998. Heritability and genetic advance for maturity and yield attributes in maize. Journal of Applied Biology, 8: 42-45.

Tang, H., Huang, Y. Q., Yan, J. B., Liu, Z. H., Tang, J. H., Zheng, Y. L. and Li, J. S. 2004. Genetic analysis of yield traits with elite maize hybrid-Yuyu 22. Acta Agronomica-Sinica, 30: 922-926.

Tengan, K. M. L., Obeng-Antwi, K. and Akromah, R. 2012. Genetic variances, heritability, and correlation studies on selected phenotypic traits in a backcross breeding program involving normal and opaque-2 maize. Agriculture and Biology Journal of North America, 3(7): 287-291.

Venugopal et al. 2003. Correlation and path analysis in maize. Crop Research Hisar, 25: 525-529.

Viola, G., Ganesh, M., Reddy, S. S. and Kumar, C. V. 2003. Studies on correlation and coefficient analysis of elite baby corn *(Zea mays* L.) lines. Progressive Agriculture, 3: 22-24.