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Assessment of association among different morphological indicators in maize

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Abstract

Maize (*Zea mays* L.) is an important cereal crop especially for developing countries like Pakistan where ever increasing population is facing the shortage of food. Maize along with other cereal crops can fulfill the future requirement of country. It gives more yields as compared to all other cereal crops. The material consisted of 20 genotypes was sown in randomized complete block design (RCBD) with two replications. Observations on following traits like Plant height, ear height, chlorophyll content, stem diameter, cob placement, cob length, cob diameter, rows/cob, kernels/row, total grains/cob, 100-grain weight and grain yield per plant were recorded on maturity. Analysis of variance showed that all the genotypes were significantly different from each other for all the above parameters. Correlation and path coefficient analysis was applied to study association among different plant parameters and to study the direct and indirect effects of those parameters to grain yield per plant. The grain yield per plant had positive significant correlation with plant height, ear height, stem diameter, cob placement, cob length, cob diameter, rows per cob, total grains per plant and 100-grain weight at the genotypic level. The path coefficient analysis showed that the traits like stem diameter, cob placement, cob length, kernels/row, 100grain weight had positive direct effect on grain yield per plant. While traits like plant height, ear height, chlorophyll content, cob diameter, rows per cob and total grains/cob exhibited negative direct effect on grain yield per plant. The maximum positive direct effect on grain yield per plant was shown by 100-grain weight while maximum negative direct effect was shown by chlorophyll content.

Keywords: Maize, yield parameters, correlation, path analysis.
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Introduction

Maize is 3rd most important cereal crop in world after wheat and rice. In Pakistan, it is grown twice a year. It is important food for human beings and feed for poultry and livestock. In 2014-15 area under maize was 1.13 million hectares which was 3.3% lesser than 2013-14. Production reduced from 4.944 million tons to 4.695 million tons almost by 3.3%. Production decreased due to decrease in area. Yield of maize was 4155 kg/hac (Government of Pakistan, 2015).

Maize is important source of raw materials for industries. It is used in the manufacturing of alcohol, dextrose, gluten, oil, custard powder, ethanol, syrup, flakes and many more products. Its grains are used to manufacture starch and glucose. The stalks of maize are used to form cardboards, insulators and papers. Polyunsaturated fatty acids are also obtained from it. It contains 10% crude protein at bloom stage which reduced to 7% at milk stage and to 6% at maturity. Nutritive value of maize is high as it contains 10% protein, 72% starch, 9.5%fiber, 4.8% oil, 1.7% ash and 3.0% sugar (Chaudhry, 1983).

In Pakistan the population is increasing so it is required to increase per unit area production in country to meet the requirements of increasing population. Being a short duration and high yield crop, maize can fulfill the needs of country. The potential of this crop is very high. The breeder can exploit genetic variability to explore this potential. It can produce a large quantity of grains in short duration to meet the need of the country

The study of correlation and path coefficient analysis provides an opportunity to select desirable parents during early generations for use in cross combinations. Correlation analysis is exclusively used by several researchers to find the association of yield with their components and different stress tolerance indices with yield (Aslam *et al.*, 2013a, b; Maqbool *et al.*, 2015). Since maize breeder is always confronted with the difficulty of choosing those inbred lines as parents, which when crossed, will result higher proportion of promising hybrids.

Path coefficient investigation is principally a reliable fractional regression coefficient and estimates diagonal and off-diagonal effect in favor of one variable upon different and permits the partition of correlation coefficient into components of direct and off-diagonal effect. The present study of relationship and path coefficient analysis of different yield associated characters certainly would be a valuable aid in selecting and breeding for the improved maize hybrids.

Materials and Methods

The experimental material consisted on 20 genotypes. In field, the 20 genotypes (ZM-1790, ZM-1791, ZM-1792, ZM-1793, ZM-1794, ZM-1795, ZM-1796, ZM-1797, ZM-1798, ZM-1799, ZM-1800, ZM-1801, ZM-1802, ZM-1803, ZM-1804, ZM-1805, ZM-1806, ZM-1807, ZM-1808, ZM-1809) were sown following randomized complete block design (RCBD) with two replications. Normal agronomic practices and plant protection measures were adopted to obtain healthy plants. Row to row and plant to plant distance was 75 and 15 cm, respectively. At maturity, the data on traits like Plant height (PH; cm), Ear height (EH; cm), Chlorophyll content (CC; mg/g), Stem diameter (SD; cm), Cob placement (CP), Cob length (CL; cm), Cob diameter (CD; cm), Rows/cob (NR/C), Kernels/row (NK/R), Total grains/cob (TG/C), 100grain weight (100GW; g) and Grain yield per plant (GY/P) was recorded in the field.

Statistical analysis:

Data recorded for different parameters was statistically analyzed by analysis of variance following the method described by Steel *et al.* (1997) and further correlation analysis was computed to study association among traits following Kwon and Torrie (1964). And direct and indirect effects were analyzed by Path coefficient analysis following by Dewey and Lu (1959).

Results and Discussion

Analysis of variance

Analysis of variance was performed for all traits and was also presented in Table 1. A comparison of all genotypes observed for plant height revealed that genotypes ZM-1796 and ZM-1805 had the highest plant height values respectively while genotypes ZM-1803 and ZM-1806 had the lowest values for plant height respectively. Genotype ZM-1805 had maximum ear height and genotype ZM-1797 had lowest ear height. Genotypes ZM-1807 and ZM-1801 had the highest chlorophyll content values respectively while genotypes ZM-1794 and ZM-1803 had the lowest values for chlorophyll content respectively. Maximum stem diameter was measured for the genotype ZM-1807 while genotype ZM-1806 had minimum value. Genotype ZM-1797 had maximum cob placement value and genotype ZM-1808 had lowest cob placement value. Genotype ZM-1809 had maximum cob length and genotype ZM-1797 had minimum value. Genotypes ZM-1806 and ZM-1807 had the highest cob diameter values respectively while genotypes ZM-1799 and ZM-1802 had the lowest values for cob diameter respectively. Genotypes ZM-1800 and ZM-1807 had the highest rows per cob values and respectively while genotypes ZM-1796 and ZM-1797 had the lowest values for rows per cob respectively. Maximum kernels per row were measured for the genotype ZM-1805 while genotype ZM-1796 had minimum value. Genotypes ZM-1807 and ZM-1808 had the highest total grains per plant values respectively while genotypes ZM-1806 and ZM-1795 had the lowest value for total grains per plant respectively. Genotypes ZM-1801 and ZM-1807 had the highest 100-grain weight values respectively while genotypes ZM-1803 and ZM-1797 had the lowest values for 100-grain weight respectively. Genotypes ZM-1801 had the highest grain yield per plant value while genotype ZM-1797 had the lowest value for grain yield per plant.

Correlation Analysis

Correlation between plant height and other traits

Plant height was positively and significantly correlated with ear height, chlorophyll content, stem diameter, cob placement, 100-grain weight and yield per plant at genotypic level and phenotypic level. Saidaiah *et al*. (2008) find out the same results. Cob length, cob diameter and total grain per plant showed positive but non-significant association with plant height at both levels (Table 2&3).

Correlation between ear height and other traits

Ear height had positive and significant association with plant height, chlorophyll content, stem diameter, cob length, kernels per row, 100-grain weight and grain yield at both genotypic and phenotypic level. Bello *et al.* (2012) investigate similar results. Cob placement was positively and non-significantly associated with ear height at genotypic level but negatively associated at phenotypic level. Rows per cob and total grain per plant had positive and non-significant association at both levels. Cob diameter had positive association at both levels. It is significant at genotypic level but non-significant at phenotypic level (Table 2 & 3).

Correlation between chlorophyll content and other traits

Chlorophyll content showed positive and significant association with ear and plant height, stem diameter, cob placement, cob length, cob diameter and 100-grain weight at both level of correlation. Praveenkumar and Sridevi (2014) report such results. Yield per plant had positive association at both levels but significant at phenotypic level and non-significant at genotypic level. Chlorophyll content had positive correlation with rows per cob, kernels per row and total grain per plant at both levels but non-significant (Table 2& 3).

Correlation between stem diameter and other traits

Stem diameter had positive and significant association with plant and ear height, chlorophyll content, cob length, cob diameter, total grains per plant, 100-grain weight and yield per plant at both genotypic and phenotypic level. Rows per cob had positive association at both levels but only significant at genotypic level. Kernels per row had positive association at both levels. Oktem (2008), Beiragi *et al.*, (2011) and Ahmadi *et al.*, (2014) reported similar types of results (Table 2& 3).

Correlation between cob placement and other traits

Cob placement showed positive and significant association at both levels of correlation with plant height, chlorophyll content, stem diameter, cob diameter and yield per plant. It had positive and non -significant association with cob length. Rows per cob and total grain per plant showed negative and non-significant association with cob placement.100-grain weight had positive association and significant at genotypic level but non-significant at phenotypic level (Table 2&3).

Correlation between cob length and other traits

Cob length had positive and significant correlation with cob diameter, rows per cob, kernels per row, total grain per plant and yield per plant at genotypic level and cob diameter had non-significant effect. Rafiq *et al.* (2010) reported similar results. Cob length had positive and significant association with rows per cob, total grain per plant, 100-grain weight and grain yield per plant at phenotypic level. It had positive and non-significant correlation with cob diameter and kernels per row at phenotypic correlation level (Table 2 & 3).

Correlation between cob diameter and other traits

Cob diameter had positive correlation with kernels per row, total grain per plant and yield per plant significant at genotypic level and non-significant at phenotypic level. Cob diameter had negative and non-significant correlation with total grain per plant at both levels. Rows per cob had positive and non-significant association at both genotypic and phenotypic level with cob diameter (Table 2 & 3). Vaezi *et al.* (2000) investigated similar results.

Correlation between rows per cob and other traits

Rows per cob had positive and highly significant relationship with kernels per row, total grain per plant, 100-grain weight and yield per plant at genotypic level. Singh *et al.* (1999) and Torun and Koycu (1999) reported similar type of results. Grain yield and 100-grain weight had positive and significant association at phenotypic level with kernel rows per cob. It had positive and non-significant association with kernels per row and total grain per plant at phenotypic level (Table 2 & 3).

Correlation between kernels per row and other traits

Kernels per row had positive and significant association with total grains per plant at genotypic and phenotypic level. Alok *et al.* (1999) had similar result. Kernels per row had positive and non- significant association with 100-grain per plant and yield per palnt at both genotypic and phenotypic level (Table 2& 3).

Correlation between total grain per plant and other traits

Total grain per plant showed positive and significant association with 100-grain weight and yield per plant at genotypic and phenotypic level. It also had positive and significant association with cob length and stem diameter at genotypic and phenotypic level. But it had negative association with cob placement at both levels (Table 2& 3).

Correlation between 100-grain weight and other traits

100-grain weight had significant and positive association with plant height, ear height, chlorophyll content, stem diameter, cob length, rows per cob and grain yield at genotypic and phenotypic level. Manivannan *et al.* (1998) investigated similar results. Kernels per row had positive and non-significant association with grain weight at both levels. Cob length had non-significant and positive association with it at genotypic level. Cob placement had positive and non-significant association with grain weight at phenotypic level (Table 2 & 3).

Correlation between grain yield per plant and other traits

Grain yield per plant had positive and significant association with plant height. Ear height, stem diameter, cob placement, cob length, cob diameter, rows per cob, kernels per row and grain weight at both genotypic and phenotypic level. Firoza *et al.* (1999), Guatam *et al.* (1999), Khan *et al.* (1999) and Kumar *et al.* (2015) reported such results in their investigations. Grain yield per plant had positive and non-significant association with kernels per row at both level. Cob diameter had positive association with grain yield per plant significant at genotypic level but non-significant at phenotypic level. Grain yield per plant had positive association with chlorophyll content. It was non-significant at genotypic level and significant at genotypic level (Table 2 & 3).

Path coefficient analysis

Direct and indirect effects of plant height on grain yield per plant

Plant height exerted negative direct effect (-0.100) on yield per plant. But paid positive indirect effect through stem diameter, cob placement, cob length, rows per cob, kernels per row and 100-grain weight. Anyhow it had negative indirect effect through chlorophyll content, ear height, cob diameter, total grains per plant. The negative value of plant height showed that it cannot be used as selection criteria for the enhancement of yield per plant (Table 4). These results are similar with the findings of Zeeshan (2007) and Oktem (2008).

Direct and indirect effects of Ear height on grain yield per plant

Ear height exerted negative direct effect (-0.097) on yield per plant. But paid positive indirect effect through stem diameter, cob placement, cob length, kernels per row and 100-grain weight. Anyhow it had negative indirect effect through chlorophyll content, plant height, rows per cob, height, cob diameter, total grains per plant. The negative value of ear height showed that it cannot be used as selection criteria for the enhancement of yield per plant (Table 4). These results are similar with the findings of Sreckov *et al.* (2011).

Direct and indirect effects of chlorophyll content on grain yield per plant

The effects of chlorophyll content were negative towards grain yield per plant (Table 4). Selection can be made on the base of this trait. The indirect positive effect of chlorophyll content through stem diameter, cob placement, cob length, kernels per row and 100-grain weight was exerted. Chlorophyll content had negative indirect effect through plant height, ear height, cob diameter, rows per cob and total grains per plant

Direct and indirect effects of stem diameter on grain yield per plant

The effects of stem diameter were positive towards grain yield per plant. Selection can be made on the base of this trait. The indirect positive effect of stem diameter through cob placement, cob length, kernels per row and 100-grain weight was exerted. Stem diameter had negative indirect effect through plant height, ear height, chlorophyll content, cob diameter, rows per cob and total grains per plant (Table 4). So the selection on these parameters will not be beneficial for maize improvement. Oktem (2008), Beiragi *et al.* (2011) and Ahmadi *et al.* (2014) also reported similar results.

Direct and indirect effects of cob placement on grain yield per plant

The effects of cob placement were positive towards grain yield per plant. Selection can be made on the base of this trait. The indirect positive effect of cob placement through stem diameter, cob length, rows per cob, total grains per plant and 100-grain weight was exerted. Cob placement had negative indirect effect through plant height, ear height, chlorophyll content, cob diameter and kernels per row (Table 4). So the selection on these parameters will not be beneficial for maize improvement.

Direct and indirect effects of cob length on grain yield per plant

The effects of cob length were positive towards grain yield per plant. Selection can be made on the base of this trait. The indirect positive effect of cob length through stem diameter, cob placement, kernels per row and total grains per plant was exerted. Cob length had negative indirect effect through plant height, ear height, chlorophyll content, cob diameter rows per cob and total grains per plant (Table 4). So the selection on these parameters will not be beneficial for maize improvement. These findings are similar with the results of Mani *et al.* (1999), Alvi *et al.* (2003), Saleem *et al.* (2007) and kumar *et al.* (2011).

Direct and indirect effects of cob diameter on grain yield per plant

It is evident from that cob diameter exerted negative direct effect (-0.012) on yield per plant. But pay positive indirect effect through stem diameter, cob placement, cob length, kernels per row, total grains per plant and 100-grain weight (Table 4). Anyhow it had negative indirect effect through ear height, plant height, rows per cob and chlorophyll content. The negative value of cob diameter showed that it cannot be used as selection criteria for the enhancement of yield per plant (Table 4).

Direct and indirect effects of rows per cob on grain yield per plant

It is evident from that rows per cob exerted negative direct effect (-0.170) on yield per plant. But pay positive indirect effect through plant height, stem diameter, cob length, kernels per row and 100-grain weight. Anyhow it had negative indirect effect through ear height, chlorophyll content, cob placement, cob diameter, total grains per plant (Table 4). The negative value of cob diameter showed that it cannot be used as selection criteria for the enhancement of yield per plant. These findings are similar with those of Tahir (1991) and Jayakumar *et al.* (2007).

Direct and indirect effects of kernels per row on grain yield per plant

The data revealed a positive direct effect of number of kernels per row on grain yield per plant. Stem diameter, cob length and 100-grain weight exhibited positive indirect effect via number of kernels per row on grain yield per plant. While there was a negative indirect effect via plant height, ear height, chlorophyll content, cob placement, cob diameter, rows per cob and total grains per plant. The selection could be made directly through number of kernels per row (Table 4). The present findings are confirmed by the investigations of Lidanski *et al.* (1987), Gautam *et al*. (1999), Alvi *et al.* (2003) and Malik *et al.* (2005).

Direct and indirect effects of total grains per plant on grain yield per plant

It is evident from data that total grains per plant exerted negative direct effect (-0.002) on yield per plant but has positive indirect effect through stem diameter, cob length, cob diameter, kernels per row, cob placement and 100-grain weight. Anyhow it had negative indirect effect through ear height, plant height, rows per cob and chlorophyll content (Table 4). The negative value of cob diameter showed that it cannot be used as selection criteria for the enhancement of yield per plant (Table 4).

Direct and indirect effects of 100- grain weight on grain yield per plant

The data in revealed a direct effect of 100-grain weight on grain yield per plant. There was a positive indirect effect via stem diameter, cob placement, cob length and kernels per row. While a negative indirect effect via plant height, ear height, chlorophyll content, cob diameter, rows per cob and total grains per plant. The selection could be made directly through number of kernels per row (Table 4). The present findings are confirmed by the investigations of Lidanski *et al.* (1987); Gautam *et al*. (1999); Alvi *et al.* (2003) and Malik *et al.* (2005).

References

Ahmadi, V., S.E. Fard and Z. Rabieyan. (2014). Correlation and path coefficient analyses of forage yield in corn hybrids as second crop. *Int. J. Biosci.*, 4: 170-175.

Alok, K., G. shetti and H.G.A. Dahiya. (1999). Analysis of direct and indirect effects of quantitative traits in all diallel crosses of maize. *Ann. Biol.*, 15: 173-176.

Alvi, M. B., M. Rafique, M. S. Tariq, A. Hussain, T. Mahmood and M. Sarwar. (2003). Character association and path coefficient analysis of grain yield andyield components maize (*Zea mays* L.). *Pak. J. Biol. Sci.*, 6:136-138.

Aslam, M., M.A. Maqbool, S. Akhtar and W. Faisal. (2013a). Estimation of genetic variability and association among different physiological traits related to biotic stress (*Fusarium oxysporum* L.) in chickpea. *J. Anim. & Plant Sci.*, 23(6): 1679-1685.

Aslam, M., M.A. Maqbool, Q.U. Zaman, M.Z. Latif, R.M. Ahmad. (2013b). Responses of Mungbean Genotypes to Drought Stress at early Growth Stages. *Int. J. Basic & Appli. Sci. IJBAS-IJENS.*, 13(5): 23-28.

Beiragi, M. A., M. Ebrahimi, K. Mostafavi, M. Golbashy and S. K. Khorasani. (2011). A study of morphological basis of corn (*Zea mays* L).yield under drought stress condition using correlation and path coefficient analysis. *J. Cereal Oil.*, 2: 32-37.

Bello, O. B., S. A. Ige, M. A. Azeez, M. S. Afolabi, S. Y. Abdulmaliq and J. Mahamood. (2012). Heritability and genetic advance for grain yield and its component characters in maize (*Zea mays* L). *Int. J. Plant Res.*, 2: 138-145.

Chaudhry, A. R. (1983). Maize in Pakistan. Punjab Agri. Res. Coordination Board, Univ. Agri. Faisalabad. Pakistan.

Dewey, D.R. and K.H. Lu. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.*, 51: 515-518.

Firoza, K, S. Begum, A. Motin, S. Yasmin and M.R. Islam. (1999). Correlation coefficient and path analysis of some maize hybrids. *Bangladesh. J. Bot.*, 28: 9-15

Gautam, A.S., R.K. Mittal and J.G. Bhandari. (1999). Correlation and path coefficient analysis in maize (*Zea mays* L). *Ann. Agri. Biotechnol. Res.*, 4: 169-171

Govt. of Pakistan. (2014-15). Pakistan Economic Survey, Ministry of Finance, Economic Advisor’s Wing, Islamabad.

Jayakumar, J., T. Sundaram, A. Raguramarajan and S. Kannan. (2007). Studies on path analysis I maize (*Zea mays* L.) for grain yield and other yield attributes. *Plant Arch.*, 7: 279-282.

Khan, J., Shafiullah and Baitullah. (1999). Correlation and path coefficient analysis in diallel crosses for yield components of maize (*zea mays* L.). *Pak. J. Biol. Sci.*, 2(4):1419-1422.

Kown, S. and J. Torrie. (1964). Heritability and interrelationship among traits of two soybean populations. *Crop Sci.*, 4: 196-198.

Kumar, T.S., D.M. Reddy and P. Sudhakar. (2011). Targeting of traits through assessment of interrelationship and path analysis between yield and yield components for grain yield improvement in single cross hybrids of maize (*Zea mays* L.). *Int. J. App. Bio. Pharm. Tech.*, 2: 123-129.

Kumar, V., S.K. Singh P.K. Bhatti, A. Sharma, S.K. Sharma and V. Mahajan. (2015). Correlation, path and genetic diversity analysis in maize (*Zea mays* L.). *Environ. Ecol*., 33: 971-975.

Lidanski, T., L. Todarova and Y.A. Velokova. (1987). Correlation and component analysis in maize. *Madras Agric. J.*, 82: 391-393.

Malik, H. N., S. I. Malik, M. Hussain, S. R. Chugtai and H. I. Javed. (2005). Genetic correlation among various quantitatives characters in maize (*Zea mays* L.) hybrids. *J. Agri. Soc. Sci.*, 3: 406-411.

Mani, V.P. and N. K. Singh. (1999). Stability analysis of yield in maize. *Indian J. Agric. Sci.*, 69:34-35.

Manivannan, N. (1998). Character association and component analysis in maize. *Madras Agric. J.*, 85: 293-294.

Maqbool, M.A., M. Aslam, H. Ali, T.M. Shah, B. Farid and Q.U. Zaman. (2015). Drought tolerance indices based evaluation of chickpea advanced lines under different water treatments. *Res. Crops*, 16 (2): 336-344.

Oktem, A. (2008). Determination of selection criterion for sweet corn using path coefficient analysis. *Cereal Res. Comm.*, 36: 561-570.

Praveenkumar, B. and O. Sridevi. (2014). Evaluation of S2 Maize (*Zea mays* L.) inbred lines for genetic variability studies under irrigated condition. *Int. J. Animal Nutr.*, 7: 2295- 2302.

Rafiq, C.M., M. Rafique, A. Hussain and M. Altaf. (2010). Studies on heritability, correlation and path analysis in maize (*Zea mays* L.). *J. Agri. Res.*, 48: 35-38.

Saidaiah, P., E. Satyanarayana and S.S. Kumar. (2008). Association and path coefficient analysis in maize (*Zea mays* L.). *Agri. Sci. Digest.*, 28: 79-83.

Saleem, A., U. Saleem and G.M. Subhani. (2007). Correlation and path coefficients analysis in maize (*Zea mays* L.). *J. Agri. Res.*, 45: 177-183.

Silva, A. R., C.L. Souza, A.M. Aguiar and A.P. Souza. (2004). Estimates of genetic variance and level of dominance in atropical maize population in grain yield and plant traits. *Maydica*, 49: 65-72.

Singh, P.K., M.K. Prasad and L. B. Chaudry. (1999). Association analysis in winter maize. *J. Appl. Biol.*, 9(2): 133-136.

Sreckov, Z., A. Nastasic, J. Bocanski, I. Djalovic, M. Vukosavljev and B. Jockovic. (2011). Correlation and path analysis of grain yield and morphological traits in test-cross population of maize. *Pak. J. Bot.*, 43: 1729-1731.

Steel, R.G.D., J.H. Torrie and D.A. Dickey. (1997). Principles and procedures of statistics: A biometrical approach (3rd ed.). McGraw-Hill, New York.

Tahir, M., A. Tanveer, A. Ali, M. Abass and A. Wasaya. (2008). Yield Composition performance of different maize (*Zea mays* L.).Hybrid under local condition of Faisalabad-Pakistan. *Pak. J. Life Soc. Sci.*, 6:118-120.

Torun, M. and C. Koycu. (1999). Study to determine the relationship between grain yield and certain yield components of maize using correlation and path coefficient analysis. *Turkish. J. Agri. &. For.*, 23: 1021-1027.

Vaezi, S. H., C. Abd-Mishani, B. Yazdi-samadi and M. R. Ghannadha. (2000). Correlation and path ana lysis of grain yield and its components in maize. *Iranian J. Agri. Sci.*, 31:71-83.

Zeeshan, M. (2007). Estimate of correlated responses for some polygenic parameters in maize (*Zea mays* L). M.Sc. Thesis Dept. Plant Breeding and Genetics Univ. Agri. Faisalabad.

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Table 1: Mean square comparison for different traits in 20 genotypes of maize

SOV	DF	PH	EH	CC	SD	CP	CL	CD	TG/C	NR/C	NK/R	100GW	GY/P
Replication	1	0.326	0.034	0.800	0.016	0.002	5.446	0.156	3814.8	0.402	38.084	2.0612	37.11
Genotypes	19	75.385*	54.902*	33.410*	0.049*	0.369*	2.120*	0.185*	12276.6*	2.545*	21.972*	33.542*	489.018*
Error	19	62.07	2.043	7.551	0.008	0.109	0.572	0.0467	2385.6	0.440	4.565	1.4026	9.417

Table 2: Genotypic correlation coefficient among morphological indicators in 20 genotypes of maize

Traits	EH	CC	SD	CP	CL	CD	NR/C	NK/R	TG/C	100GW	GY/P
PH	0.42**	0.434**	0.609**	0.438*	0.276	0.152	-0.152	0.016	0.063	0.436**	0.459**
EH		0.533**	0.578**	0.018	0.601**	0.386*	0.254	0.645**	0.291	0.594**	0.493**
CC			0.686**	0.621**	0.857**	0.640**	0.285	0.067	0.261	0.969**	1.022
SD				0.731**	0.686**	0.462**	0.55**	0.187	0.547**	0.598**	0.666**
CP					0.045	0.439**	-0.086	-0.258	-0.253	0.334*	0.420**
CL						0.326*	0.51**	0.323*	0.842**	1.011	0.969**
CD							0.211	0.334*	-0.109	0.404**	0.317*
NR/C								0.410**	0.458**	0.425**	0.353*
NK/R									0.562**	0.212	0.158
TG/P										0.396*	0.434**
100GW											0.992**

Table 3: Phenotypic correlation coefficient among morphological indicators in 20 genotypes of maize

Traits	EH	CC	SD	CP	CL	CD	NR/C	NK/R	TG/P	100GW	GY/P
PH	0.39*	0.314*	0.529**	0.287	0.165	0.104	-0.132	-0.051	0.083	0.406**	0.416**
EH		0.492**	0.435**	-0.005	0.462**	0.222	0.253	0.443**	0.257	0.591**	0.469**
CC			0.492**	0.384*	0.699**	0.348*	0.271	0.002	0.263	0.832**	0.762**
SD				0.314*	0.479**	0.292*	0.255	0.217	0.403**	0.512**	0.504**
CP					0.158	0.338*	0.034	-0.162	-0.157	0.247	0.372*
CL						0.239	0.461*	0.250	0.413**	0.771**	0.723**
CD							0.176	0.228	-0.019	0.266	0.278
NR/C								0.194	0.247	0.329*	0.319*
NK/R									0.370*	0.120	0.119
TG/P										0.320*	0.330*
100GW											0.928**

Table 4: Direct and indirect effects of different traits in 20 genotypes of maize

Traits	PH	EH	CC	SD	CP	CL	CD	NR/C	NK/R	TG/C	100GW
PH	-0.100	-0.041	-0.310	0.004	0.186	0.080	-0.002	0.026	0.001	0.000	0.615
EH	-0.042	-0.098	-0.381	0.004	0.007	0.174	-0.005	-0.043	0.039	0.000	0.838
CC	-0.044	-0.052	-0.714	0.005	0.264	0.249	-0.007	-0.049	0.004	0.000	1.367
SD	-0.061	-0.056	-0.490	0.007	0.311	0.199	-0.005	-0.093	0.011	-0.001	0.844
CP	-0.044	-0.002	-0.443	0.005	0.425	0.013	-0.005	0.015	-0.015	0.000	0.471
CL	-0.028	-0.059	-0.612	0.005	0.019	0.290	-0.004	-0.087	0.019	-0.001	1.426
CD	-0.015	-0.038	-0.457	0.003	0.187	0.095	-0.012	-0.036	0.020	0.000	0.570
NR/C	0.015	-0.025	-0.204	0.004	-0.037	0.148	-0.002	-0.170	0.025	-0.001	0.599
NK/R	-0.002	-0.063	-0.048	0.001	-0.110	0.094	-0.004	-0.070	0.060	-0.001	0.300
TG/C	-0.006	-0.028	-0.186	0.004	-0.107	0.244	0.001	-0.078	0.034	-0.001	0.558
100GW	-0.044	-0.058	-0.692	0.004	0.142	0.293	-0.005	-0.072	0.013	0.000	1.411