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Phenotypic correlations and path analysis between ear yield and other associated characters in corn hybrids (Zea mays L.)

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ABSTRACT: Corn ranks third among the cereal crops worldwide after wheat and rice. Corn is produced primarily for animal feed and industrial uses and it is partitioned as follow about 35% for human nutrient requirement, about 65% for animal feed. Several workers have attempted to determine linkage between the characters on which the selection for high yield can be made. Because of that, genetic variability assessment and determination of the best selection criteria were conducted by using 16 dent corn hybrids in the randomized complete block design with four replications. Analysis of variance showed the significant difference among corn hybrids for all the traits except days to physiological maturity and days from silking until physiological maturity. Mean comparison between them revealed hybrids no 15 and16 had high ear and protein yield and days to physiological maturity. Therefore, hybrid 16 had proper genetic potential to introduce as promising variety to sow in normal condition. On the other hand, hybrid 15 recommend for stress prone environments. Correlation analysis showed the significant relationship of majority of the traits with ear yield. Step-wise regression revealed that 79.6% of variation exist in ear yield accounted for by protein yield. Evaluation of direct and indirect effects of protein yield and percentage on ear yield by using path analysis demonstrated the efficiency of selection for high quantity of these traits to improve ear yield in corn hybrids. In conclusion, results showed possibility of ear yield improvement by using protein yield and protein percentage ae well as ear weight as selection criteria. Furthermore, indirect selection for traits such as grain weight and ear weight had positive effects on ear yield enhancement.

***Keywords*:** Maize, correlation, step-wise regression, path analysis, selection criteria

INTRODUCTION

Maize crop plays an important role in the world economy and is valuable ingredient in manufactured items that affect a large proportion of the world population (Alvi et al., 2003). Correlation coefficient analyses help researchers to distinguish significant relationship between traits. Step-wise regression can reduce effect of non-important traits in regression model, in this way traits accounted for considerable variations of dependent variable are determined (Agrama, 1996). Path analyses that present by (Li ,1956) have been extensively used for segregating correlation between yield and its components in field crops. Path analysis is used to determine the amount of direct and indirect effects of the variables on the dependent variable (Li, 1956; Farshadfar et al., 1993).

Selection is a widely used and successful method in plant breeding. Response to selection depends on many factors such as the interrelationship of the characters. Plant breeders work with some yield components related to yield in the selection programs and it is very important to determine relative importance of such characters contributing to grain yield directly or indirectly. Correlation and path coefficient analyses can assist to determine certain characters to be used in the improvement of the complex character such as yield (Joshi, 2005; Kusaksiz, 2010). Information about correlative characters in sweet corn has been still very limited. The direct and indirect effects of specific yield components could be precisely identified and applied in breeding programs of sweet corn by determining of inter-relationship among fresh grain yield and yield components.

(Mohammadi et al., 2003) reported that 100-grain weight and total number of kernels per ear revealed highest direct effects on total grain weight ($p = 0.74$ and $p = 0.78$, respectively), while ear length, ear diameter, number of kernel rows, and number of kernels per row were found to fit as second-order variables.

The direct and indirect effects of different quantitative traits on grain yield were studied in 90 hybrids by Geetha and (Jayaraman ,2000), (Annapurna et al., 1998) and Mohammadi et al., 2003) and they reported that number of grains per row exerted a maximum direct effect on grain yield. Hence, selection of number of grains per row will be highly effective for improvement of grain yield. (Kumar and Kumar ,2000) put emphasis on plant height with greater ear weight, number of grain rows per ear and number of grains per ear for better grain yield.

(Devi et al .,2001) reported that ear length, number of grain rows ear-1, number of grains row-1 and 100-grain weight positively influenced the yield directly and also indirectly through several components.

A review of the works of other researchers indicates that determining relationships between yield and its components has special importance. Although the results of all experiments were not in agreement with each other, but in the most experiments some yield components such as 100–kernel weight, kernel per row and kernel per ear has big importance in determining yield. Thus, by determining reaction of corn grain yield under nitrogen levels at different planting dates, and recognition of the traits that has significant effect on yield, we can obtain great success in better programming of Agronomy management and breeding of progressive hybrids (Nemati et al., 2009).

(Mani et al .,1999) studied that grain yield plant-1 indicated highly significant positive correlation with all the other attributes.

Aim of this study was to determine ear yield components through phenotypic correlation and path coefficient analyses so they would be utilized by the breeders to develop new dent corn genotypes with high yielding capacity. The goal of present study were to determine the usefulness of a regression and path analysis as well as to analyze the associations between ear yield and related characters in maize by applying the model to different datasets, with special attention on the analysis of co-linearity of various predictor variables and analyzing the predictive value of the model.

MATERIALS AND METHODS

Sixtheen dent corn hybrids were planted at the 15 June 2012 at the research field of Jehad-Agriculture Research Institute of Isfahan, Isfahan, Iran. The experimental area has a heavy soil structure with clay-silt soil at 0-20 cm depth and clay-loamy structure at 20-40 cm depth. Standard agronomical practices were applied. Each plot had four rows 3 m length with spacing 70 cm between rows and 20 cm between plants (Turgut, 2000). Two seeds were planted in each hill and then thinned to one plant to have a final plant density of 71420 plants ha-1. Harvest was done at the end of the milk stage of seed for each variety.

Along growing season recording and sampling were conducted to measure studied traits. Samplings were conducted from four internal rows and by considering boarder effect of each side of the rows. After harvesting ears from selected plants and separating grains from corn-cob, at first grains weighted and then the moisture percent of 150 grains was determined.

Observations and measurements were done for fifteen characters such as ear weight, no.grain/ear, no.grain/row, ear diameter, grain depth, humidity percent, 100-grain weight, ear yield, days from anthesis and days from silking until physiological maturity, days to physiological maturity, plant height, ear height, protein percentage and protein yield on twenty normal plants that were harvested from middle two rows of the each plot.

Relationships between traits were investigated using phenotypic correlation coefficient analysis. Step-wise regression was conducted to determine the best model, which accounted for variation exist in plant seed yield as dependent variables in separate analysis. Direct and indirect effects of traits entered to regression model were determined by using path coefficient analysis. In this study, path analysis was carried out based on method given by (Dewey and Lu ,1959). Data analysis was conducted using $SPSS_{19}$ and Path2 softwares.

RESULTS AND DISCUSSION

Analysis of variance revealed significant difference between corn hybrids for all the traits studied except for days from silking to physiological maturity and days to physiological maturity. Phenotypic correlation coefficient analysis showed significant and positively relationship among ear yield with all the traits. On the other hand, correlation of protein yield with the traits; ear weight, ear yield and protein percentage were positively significant.

The high correlation of grain yield with the number of rows per ear is reported by other researchers (Corke and Kannenberg, 1998; Mohammadi et al., 2003). (Agrama ,1996) reported that the number of rows per ear has the most great direct effect on grain yield. Increasing cob diameters caused an increase in the number of rows per ear and consequently increases in the number of rows per ear. In other words, grain yield with the cob diameters that caused the increase in kernel per ear, indicated positive and significant correlation. Consumption of 150 Kg nitrogen per hectare, by significant increasing of cob weight, increased kernel per ear and also increased grain yield significantly.

Step-wise regression analysis showed that the traits protein yield and protein percentage were the main components of ear yield in corn hybrids. Amongst, protein yield accounted for 79.6% of total variation exist in ear yield (Table 1). Protein percentage acconted for 19.8 and of total variation of ear yield.

(Nemati et al., 2009) and (Henfy ,2011) reported the importance of protein yield and phenological traits along with ear weight in ear yield variation. The findings given by (Öktem ,2008) and (Alvi et al .,2003) are inconsistent with my results. (Mohammadi et al., 2003) reported the highest of correlation between ear yield and plant height. Furthermore, highly significant were observed among ear yield and no.grain/ear, 300-grain weight, no.grain/row, ear length, ear height and stem diameter. Breeders should be determined the traits strongly correlated with ear yield in corn genotypes (Nemati et al., 2009).

Path coefficient analysis revealed the highest positive and direct effect of protein yield on ear yield (Table 2). Because of that, protein yield is the best indirect selection criterion to improve ear yield. On the other hand, protein percentage has negative and direct effect on ear yield. This trait isn't promise criterion to increase ear yield. Moreover, indirect effect of protein percentage via protein yield on ear yield was positive and considerable. Because of that indirect effects of this trait should be considered along with direct effect of protein yield on ear yield.

Furthermore, principal component analysis showed the high effect of protein yield and ear weight on the trait ear yield. Selection for the highest amount of the traits such as grain weight along with ear weight have promising results to improve ear yield in corn hybrids. Similar results given by (Henfy ,2011) and (Oktem ,2008) in relation of PCA analysis of agronomic traits, ear and protein yield in corn hybrids.

In conclusion, indirect selection should be used through traits having the highest direct effect on dependent variables in early generations. These traits usually determine by means of statistical procedure such as correlation, step-wise regression and path coefficient analysis. Based on findings of present study, indirect selection for traits such as protein yield, grain weight and ear weight as selection criteria can be suggested to improve ear yield of dent corn hybrids specifically in preliminary generations. On the other hand, traits protein percentage and plant height have lower importance than others as selection criteria.

Table 1. Step-wise regression for ear yield (dependent variable) in corn hybrids

Variable	$b_{(1)}$	Partial R^2	Model R^2	F
Protein yield	8.394	79.6	79.6	**
Protein percentage	-105.369	99.4	19.8	**
Intercept	12576.141			

Table 2. Path analysis for ear yield in corn hybrids

Variable	(1)	(2)	Sum of effects
(1) Protein yield	1.075	-0.204	0.871
(2) Protein percentage	0.413	-0.528	-0.115
Residual effects	0.046		

REFERENCES

Agrama HAS. 1996. Sequential path analysis of grain yield and its components in maize. Plant Breeding. 115:343-346.

Alvi MBM, Rafique M, Tariq S, Hussain A, Mahmood T, Sarwar M. 2003. Character association and path coefficient analysis of grain yield and yield components maize (Zea mays L.). Pak. J. Biol. Sci. 6(2):136-138.

Annapurna D, Khan HA, Mohammad S. 1998. Genotypic–phenotypic correlations and path coefficient analysis between seed yield and other associated characters in tall genotypes of maize. Crop Res. Hisar. 16: 205-9.

Corke H, Kannenberg LW. 1998. Selection for vegetative phase and actual filling period duration in short season maize. Crop Sci. 29:607-612.

Devi IS, Muhammad S, Muhammad S. 2001. Character association and path co-efficient analysis of grain yield and yield components in double crosses of maize. Crop Res. 21:355-359.

Dewey DR, Lu KH. 1959. A correlation and path-coefficient analysis of components of crested wheat-grass and production. Agron. J. 51:515-518.

Farshadfar E, Galiba B, Kozsegi Sutka J. 1993. Some aspects of the genetic analysis of drought tolerance in wheat. Cereal. Res. Commun. 21:323-330.

Geetha K, Jayaraman N. 2000. Path analysis in maize (Zea mays L.). Agric. Sci. Digest. 20:60-1.

Hefny M. 2011. Genetic parameters and path analysis of yield and its components in corn inbred lines (Zea mays L.) at different sowing days. Asian Journal of Crop Science 3(3):106-117.

Joshi BK. 2005. Correlation, regression and path coefficient analyses for some yield components in common and Tartary buckwheat in Nepal. Fagopyrum 22: 77-82.

Kumar MVN,. Kumar SS. 2000. Studies on character association and path coefficients for grain yield and oil content in maize (Zea mays L.). Ann. Agric. Res., 21:73–8.

Kusaksiz T. 2010. Adaptability of some new maize (Zea mays L.) cultivars for silage production as main crop in Mediterranean environment. Turk. J. of Field Crops 15(2): 193-197.

Li CC. 1956. The concept of path coefficient and its impact on population genetics. Biometrics.12:190-210.

Mani VP, Singh N K, Bisht GS, Sinha MK. 1999. Variability and path coefficient study in indigenous maize germplasm. Environ. Ecol. 17:350-3.

Mohammadi SA, Prasanna BM, Singh NN. 2003. Sequential path model for determining interrelationship among grain yield and related characters in maize. Crop Sci. 43: 1690-1697.

Nemati A, Sedghi M, Sharifi RS, Seiedi MN. 2009. Investigation of Correlation between Traits and Path Analysis of Corn (Zea mays L.) Grain Yield at the Climate of Ardabil Region (Northwest Iran). Not. Bot. Hort. Agrobot. Cluj. 37(1): 194-198.

Oktem A. 2008. Determination of selection criterions for sweet corn using path coefficient analyses. Cereal Research Communications 36(4): 561–570.

Turgut I. 2000. Effects of plant populations and nitrogen doses on fresh ear yield and yield components of sweet corn (Zea mays saccharata Sturt.) grown under Bursa conditions (in Turkish with English abstract). Turk. J. Agric. For. 24: 341–347.