Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2157

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **3 (6):** 21-25 (2015)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Correlation Studies in Tropical-Temperate Maize Populations

Justin Abadassi*

Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, 03 BP 2547 Cotonou, Bénin

*Corresponding Author E-mail: jabadassi@gmail.com

ABSTRACT

Correlation studies were carried out in two tropical-temperate maize populations which need to be improved for a few agronomic traits in order to choose an efficient breeding strategy. Random sets of S_1 families of the populations were evaluated in a 10 × 10 triple lattice in savanna zone in Benin. The traits studied were: earliness (days to 50% anthesis, silking and maturity, number of leaves), plant and ear heights, grain yield, and harvest index. Linear phenotypic correlation coefficients were estimated for all pairs of traits and tested for significance. Days to 50% anthesis, days to 50% silking, and days to 50% maturity were highly and positively correlated in the two populations. Plant height was highly and positively correlated with ear height in both populations. It was significantly correlated with the four earliness variables studied in EV8443SR × (EV8443SR ×DEA) (EDE) but significantly correlated with only one of them (number of leaves) in EV8443SR ×DEA (ED). Grain yield was not linearly correlated with cycle duration. It was highly and positively correlated with plant height in ED but not correlated with it in EDE. Harvest index was significantly and negatively correlated with the four earliness variables in EDE and with days to 50% anthesis and days to 50% silking in ED. It was highly and positively correlated with grain yield in the two populations. Therefore, selection for days to 50% anthesis, silking or maturity (any of the three variables) can improve the populations for earliness. Selection for high harvest index may increase grain yield in the two populations.

Key words: *agronomic traits, Benin, breeding, correlation, maize.*

INTRODUCTION

Maize (*Zea mays* L.) is a worldwide crop and is largely utilized for human and animal feeding. It is the most important cereal crop in sub-Saharan Africa[18]. In Benin, maize is the most cultivated food crop; but, the average grain yield is low (less than 1.5 t/ha)[11] , due to technical, biological, socio-economic, and climatic constraints[2].

Traditional populations are the most cultivated maize varieties in Benin. The improved varieties introduced notably from the International Institute of Tropical Agriculture (IITA) and the International Maize and Wheat Improvement Center (CIMMYT) are lowly accepted by the producers and the consumers due to their deficiencies. They need to be improved for important agronomic traits. A breeding programme has, therefore, been elaborated for that purpose. Selected temperate material was introgressed into some varieties and promising tropical-temperate populations were obtained. But, those populations still need to be improved for certain traits by selection.

Cite this article: Abadassi, J., Correlation Studies in Tropical-Temperate Maize Populations , *Int. J. Pure App. Biosci.* **3(6):** 21-25 (2015). doi: http://dx.doi.org/10.18782/2320-7051.2157

Correlation studies are very important in breeding programmes. They help breeders to choose the most suitable selection strategy. Several authors including Chase and Nanda[8], Jacquot[19], El-Lakany and Russel[9], Monteagudo[22], Allen *et al.*[5], Josephson and Kincer[20], Fakorede[10], Muldoon *et al.*[23], Reddy *et al.*[25], Helms and Compton[17], Kim and Hallauer[21], Hébert *et al.*[16], Agbaje *et al.*[4], Yousuf and Saleem[26], Gyenes-Hegyi *et al.*[14], Buhinicek *et al.*[7], Barros *et al.*[6], Golam *et al.*[12], and Nzuve *et al.*[24] studied correlations between agronomic traits in maize. But, the results vary with traits, population, and location. This work was, therefore, undertaken to determine the correlations between key agronomic traits in two promising tropical-temperate maize populations developed in Benin which need to be improved for a few agronomic traits.

MATERIALS AND METHODS

The two populations studied are:

- EV8443SR × DEA (ED), a tropical-temperate population obtained in crossing EV8443SR, an elite tropical maize population bred by IITA and CIMMYT with DEA, a single hybrid widely cultivated in France
- EV8443SR × (EV8443SR ×DEA) (EDE), a tropical-temperate population obtained in backcrossing EV8443SR × DEA to EV8443SR.

The two populations are relatively late-maturing, have relatively great plant heights and low grain yields and harvest indexes. They need, therefore, to be improved for earliness, plant height, grain yield, and harvest index.

Random sets of 50 S_1 families from each population were grown for evaluation in Benin, at Bembéréké (savanna zone, latitude: 9°58’N; longitude: 2°44’E; altitude: 358 m) in a 10 × 10 triple lattice. Each family was planted in two 2 m rows separated by 0.80 m. Consecutive hills along each row were 0.50 m apart. The plots were overplanted and thinned to 2 plants per hill (50000 plants.ha^{-1}). Optimal fertilization and weeding were realized. Sufficient and well distributed rainfall was noted during the growing season.

The traits studied were: earliness (days to 50% anthesis, silking and maturity (dried husks), number of leaves), plant height, ear height, grain yield, and harvest index. Days to 50% anthesis, silking, and maturity (days after planting), plant height (distance between soil surface and panicle base) and ear height (distance between soil surface and the higher ear insertion point) were recorded on a plot basis. Grain yield was noted per plot at 15% moisture. Harvest index (hi) was calculated as follows:

$$hi = ew/epw$$

with ew = weight of the ears harvested on the plot; epw = weight of all the plants harvested on the plot.

For each population, the simple linear phenotypic correlation coefficient r between two traits X and Y was estimated using the formula:

$$r = Cov (X,Y) / [V(X)V(Y)]^{1/2}$$

where Cov (X,Y) = phenotypic covariance of X and Y; V(X) = phenotypic variance of X; V(Y) = phenotypic variance of Y.

Coefficients significance was tested following the procedure indicated by Gomez and Gomez[13].

RESULTS AND DISCUSSION

The simple linear phenotypic correlations matrix per population is shown by tables 1 and 2. Days to 50% anthesis, days to 50% silking and days to 50% maturity were highly (significance at the 1% level) and positively correlated in both populations. Kim and Hallauer[21] and Buhinicek *et al.*[7] reported also that days to anthesis and days to silking were highly and positively correlated. Any of the three variables is, therefore, sufficient for efficient selection for earliness in the two populations. Number of leaves was highly and positively correlated with the three other earliness variables studied in EDE. It was highly and positively correlated with days to 50% anthesis and days to 50% silking but not significantly correlated with days to 50% maturity in ED. Correlation between days to silking and number of leaves was also found by Chase and Nanda[8].

Table 1. Simple linear correlation matrix of the variables in population EV8443SR × DEA (ED)

Variables	Days to 50% anthesis	Days to 50% silking	Days to 50% maturity	Number of leaves	Plant height	Ear height	Grain yield	Harvest index
Days to 50% anthesis	1							
Days to 50% silking	0.735**	1						
Days to 50% maturity	0.503**	0.589**	1					
Number of leaves	0.507**	0.409**	0.233ns	1				
Plant height	0.263ns	0.125ns	0.131ns	0.377**	1			
Ear height	0.281*	0.176ns	0.137ns	0.380**	0.642**	1		
Grain yield	0.021ns	-0.170ns	0.160ns	0.129ns	0.455**	0.344*	1	
Harvest index	-0.314*	-0.421**	-0.073ns	0.009ns	0.143ns	0.058ns	0.427**	1

** Highly significant (1% level); * Significant (5% level); ns non significant

Table 2. Simple linear correlation matrix of the variables in population EV8443SR × (EV8443SR ×DEA) (EDE)

Variables	Days to 50% anthesis	Days to 50% silking	Days to 50% maturity	Number of leaves	Plant height	Ear height	Grain yield	Harvest index
Days to 50% anthesis	1							
Days to 50% silking	0.723**	1						
Days to 50% maturity	0.556**	0.708**	1					
Number of leaves	0.532**	0.534**	0.398**	1				
Plant height	0.303*	0.320*	0.343*	0.346*	1			
Ear height	0.159ns	0.220ns	0.243ns	0.305*	0.706**	1		
Grain yield	-0.168ns	-0.182ns	0.092ns	0.040ns	0.110ns	0.053ns	1	
Harvest index	-0.307*	-0.283*	-0.344*	-0.386**	-0.244ns	-0.105ns	0.373**	1

** Highly significant (1% level); * Significant (5% level); ns non significant

Plant height was highly and positively correlated with ear height in both populations. That result agrees with those reported by Kim and Hallauer[21] and Gyenes-Hegyi *et al.*[14]. Plant height was significantly correlated with the four earliness variables studied in EDE but significantly correlated with only one of them (number of leaves) in ED. Correlation between vegetative cycle duration and plant height was earlier reported by Jacquot[19].

Grain yield was not significantly correlated with any of the four earliness variables studied in any of the two populations. The absence of significant linear correlation between grain yield and cycle duration was not expected. Usually, the two variables are positively correlated in maize. Nevertheless, that result agrees with those obtained by Abadassi[1,3]. The discordance may be due to the genetic constitution of the populations. The non-correlation between grain yield and cycle duration may facilitate selection for satisfactory levels of grain yield and earliness. Grain yield was highly and positively correlated with plant height in ED but not correlated with it in EDE. El-Lakany and Russel[9] found also that grain yield was significantly correlated with plant height in testcrosses whereas Fakorede[10] didn't notice any correlation between the two traits in a synthetic population. The absence of linear correlation between grain yield and plant height in EDE may facilitate selection for reduced plant height and satisfactory grain yield. At the opposite, the high and positive correlation between grain yield and plant height in ED may complicate such a selection.

Harvest index was significantly and negatively correlated with the four earliness variables in EDE and with days to 50% anthesis and days to 50% silking in ED. It was highly and positively correlated with grain yield in the two populations. According to Hay and Gilbert[15], harvest index may be highly heritable in maize. Therefore, grain yield increase may be obtained through selection for high harvest index in the two populations studied.

CONCLUSION

Days to 50% anthesis, days to 50% silking, and days to 50% maturity were highly and positively correlated in the two tropical-temperate maize populations studied. Plant height was highly and positively correlated with ear height in both populations. It was significantly correlated with the four earliness variables studied in EDE but significantly correlated with only one of them (number of leaves) in ED. Grain yield was not linearly correlated with cycle duration. It was highly and positively correlated with plant height in ED but not correlated with it in EDE. Harvest index was significantly and negatively correlated with the four earliness variables in EDE and with days to 50% anthesis and days to 50% silking in ED. It was highly and positively correlated with grain yield in the two populations. Therefore, selection for days to 50% anthesis, silking or maturity (any of the three variables) can improve the populations for earliness. Selection for high harvest index may increase grain yield in the two populations.

REFERENCES

1. Abadassi, J., Comparison of two types of improved tropical maize populations in Benin. *African Journal of Agricultural Research*, **8(11):** 952-956 (2013).
2. Abadassi, J., Maize (*Zea mays* L.) and cowpea (*Vigna unguiculata* (L.) Walp.) production constraints in Benin. *International Journal of Science and Advanced Technology*, **4(1):** 10-19 (2014a).
3. Abadassi, J., Characterization of traditional maize populations cultivated in Benin. *International Journal of Biological and Chemical Sciences*, **8(2):** 434-442 (2014b).
4. Agbaje G.O., Abayomi, Y.A. and Awoleye, F., Grain yield potential and associated traits in maize (*Zea mays* L.) varieties in the forest zone of Nigeria. *Ghana J. Agric.Sci.*, **33:** 191-198 (2000).
5. Allen, J.R., Mckee, G.W. and McGahen, J.H., Leaf number and maturity in hybrid corn. *Agron. J.*, **65:** 233-235 (1973).
6. Barros, L.B., Moreira, R.M.P. and Ferreira, J.M., Phenotypic, additive genetic and environment correlations of maize landraces populations in family farm systems. *Sci. Agric.*, **67:** 685-691 (2010).
7. Buhinicek, I., Palaversic, B., Brkic, A. and Sarcevic, H., Correlations among agronomic traits in FAOSYNFR1B maize populations. *Sjemenarstvo*, **24:** 147-158 (2007).
8. Chase S.S. and Nanda D.K., Number of leaves and maturity classification in *Zea mays* L. *Crop Sci.*, **7:** 431-432 (1967).
9. El-Lakany, M.A. and Russel, W.A., Relationship of maize characters with yield in testcrosses of inbreds at different plant densities. *Crop Sci.*, **11:** 698-701 (1971).

10. Fakorede, M.A.B., Interrelationships among grain yield and agronomic traits in a synthetic population of maize. *Maydica*, **24:** 181-192 (1979).
11. FAO, FAO Statistical yearbook 2013. FAO, Rome, Italy (2013).
12. Golam, F., Farhana N., Zain, M.F., Majid, N.A., Rahman, M.M., Rahman, M. motior and Kadir M.A., Grain yield and associated traits of maize (*Zea mays* L.) genotypes in Malaysian tropical environment. *Afr. J. Agric. Res.*, **6:** 6147-6154 (2011).
13. Gomez, K.A. and Gomez, A.A., Statistical procedures for agricultural research. Second Edition. John Wiley and Sons, New York (1984).
14. Gyenes-Hegyi, Z., Pok I., Kizonus, L., Zsubori, Z., Nagy, E. and Marton, L.C., Plant height and the height of the main ear in maize (*Zea mays* L.) at different locations and different plant densities. *Acta Agronomica Hungarica*, **50:** 75-84 (2002).
15. Hay, R.K.M. and Gilbert, R.A., Variation in the harvest index of tropical maize: evaluation of recent evidence from Mexico and Malawi. *Annals Appl. Biol.*,**138:** 103-109 (2001).
16. Hébert, Y., Duparque, A. and Pellerin, S., Verse en végétation : la variabilité génétique du système racinaire et de l'appareil aérien du maïs et ses conséquences pour la sélection. In : Bourdu R., Picard D. and Bloc D. (eds.) Physiologie et production du maïs. INRA, Paris, pp. 203-212 (1990).
17. Helms, T.C. and Compton, W.A., Ear height and weight as related to stalk lodging in maize. *Crop Sci*., **24:** 923-924 (1984).
18. IITA, Maize. IITA, Ibadan, Nigeria (2009).
19. Jacquot, M., Amélioration variétale du maïs en Casamance (Sénégal). *L'Agron. Trop.*, **25:** 28-43 (1970).
20. Josephson, L.M. and Kincer, H.C., Selection for lower ear placement in two synthetic populations of maize. *Crop Sci.*, **17:** 499-502 (1977).
21. Kim, S.K. and Hallauer, A.R., Agronomic traits of tropical and subtropical maize inbreds in Iowa. *Plant Varieties Seeds*, **2:** 85-91 (1989).
22. Monteagudo A., Ear number and yield in maize. *Proc. VI Meeting Maize and Sorghum Section of Eucarpia*:109-120 (1971).
23. Muldoon, J.F., Daynard, T.B., Duinen, B. and Tollenaar, M., Comparisons among rates of appearance of leaf tips, collar and leaf area in maize (*Zea mays* L.). *Maydica*, **29:** 109-120 (1984).
24. Nzuve, F., Githiri, S., Mukunya, M. and Goethi, J., Genetic variability and correlation studies of grain yield and related agronomic traits in maize. *Journal of Agricultural Science*, **6:** 166-176 (2014).
25. Reddy, P.R.R., Satyanarayana, E. and Kumar, R.S., Maturity components of inbred lines and single crosses of maize (*Zea mays* L.). *Annals Agric. Res.*, **7:** 337-342 (1986).
26. Yousuf, M. and Saleem, M., Correlation analysis of S1 families of maize for grain yield and its components. *International Journal of Agriculture and Biology*, **3:** 387-388 (2001).