MATURITY ESTIMATE AND GENETIC CORRELATION AMONG VARIOUS QUANTITATIVE CHARACTERS IN MAIZE (*ZEA MAYS L.)* ACCESSIONS OF SOUTH EASTERN NIGERIA

Onyishi, G.C. Ngwuta, A.A., and Keyagha, E.R.
Department of Crop Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria.
Corresponding author's e-mail: **gonyishi@yahoo.com**

Abstract
The study appraised the genetic correlation among various quantitative traits of maize (*Zea mays L*) and the relationship between tasseling and silking time with time of maturity. The research was carried out at the Teaching and Research Farm of the Federal University of Technology, Owerri, Nigeria, during the 2011 and 2012 cropping seasons. Maize accessions from southeastern Nigeria were evaluated in a randomized complete block design with three replications. Significant positive correlations were recorded between grain yield, and 100-seed weight, ear weight; and between days to physiological maturity and days to tasseling, days to silking, and ear weight. The result of the study indicates that silking and tasseling time could be used to estimate the time of maturity in maize. Seventeen of the twenty accessions were found to be intermediate maturing while three Oka Emekuku, Mkpamkpa, and Oka Nwaduala were late maturing.

Key words: Genetic correlation, maturity, *Zea mays L.*, Accessions,

Introduction

Maize (*Zea Mays L.*) is of the family Poaceae, and is an important cereal crop throughout the world. It ranked the second most important food crop after cassava in Africa (Devries and Toennisen, 2001). Maize serves as sources of income to small and large scale farmers in developing countries (Ahmed and Yusuf, 2007). It can be used as forage and in the manufacture of livestock feed-stuffs, sweeteners, beverage, industrial alcohol, and oil (Moyin – Jesu, 2010).

The term maturity implies that the plant has been brought to completeness of growth and development. In grain producing crops, maturity will be attained as soon as the seeds are ready to serve their reproductive purpose. In maize approximately 30 days after silking, the plant will reach the maximum dry weight, a stage described as physiological maturity. This is when a "black layer" is noticeable at the tip of each kernel. At this stage, the cells die and further starch accumulation into the kernel is blocked, and the milk line has completely disappeared (Baker, 1973; Ritchie et al., 1997).

Relative maturity is an important criterion in maize selection for improvement. Obi (1991) classified maize cultivars that take less than 90 days from time of planting to physiological maturity as early maturing and those that matures after 120 days as late maturing. Babu-Apraku *et al.(*2001) grouped cultivars maturing 80 to 85 days as extra early, 90 to 95 days as early, 110 to 120 intermediate and 120 days and above as late maturing. Hybrids of similar relative maturity may have slightly different developmental patterns; hybrids with similar grain moisture percentage at grain harvest may have different tasseling and silking dates and consequently, grain filling can occur at a later date.

Thjis-Tollenaar, (2012) indicated that any assessment of the impact of maize maturity on yield and grain quality should be based on an appreciation of the development stages of maize.

The availability of maturity ratings for maize cultivars is of importance for both farmers and breeders, especially in planning the cropping programme, as well as in classifying them for use as basic breeding materials. Some varieties must be extra early in maturity in order to provide a high yield of sound grain within the limits of the growing season, or for multiple cropping. Late maturity varieties are also needed in other areas to take full advantage of extremely long growing seasons.

Genetic correlation analysis is a handy technique which elaborates the degree of association among important quantitative traits. Grain yield exhibits quantitative variation and it is controlled by several genes. Genes involved expresses in additive manner in different grain development pathways, each contributing to the final yield (Ibarbia and Lambeth, 1969).

The result of correlation is of great value in the evaluation of the most effective procedures for selection of superior genotypes in crop improvement (Fakorede and Opeke, 1985). The genetic base of the material under study and the effects of environment are very important while studying genetic correlation among various quantitative characters in crop species.

The study was therefore, undertaken to:-

- Assess the genetic correlation among various quantitative characters of maize.
- Estimate the maturity time of the various maize accessions of south east, Nigeria with particular reference to tasseling and silking time and to classify them for use as basic breeding germplasm.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm of the Federal University of Technology, Owerri, Imo State, Nigeria in the 2011 and 2012 growing season, and was laid out in a randomized complete block design with three replications. The site is located on latitude 5^{o}27'N and longitude 7^{o}02' on an elevation of 55.0m above sea level in the humid tropics of south eastern Nigeria. The temperature was moderate with high relative humidity and rainfall pattern that is consistent with that in humid tropical zones. The soil is classified as ultisol (Eshett, 1993). Twenty maize accessions were sourced from different locations of southeastern Nigeria as shown in Table 1. The land area used was 45m by 9.5m. One seed was planted per hole at an inter-row spacing of 0.25m and inter-row spacing of 0.75m giving a theoretical plant population of 53,333 plants per hectare. Harvesting was done when the plants reached their physiological maturity using black layer formation as an index of maturity (Baker, 1973; Ritchie et al., 1997).

The NPK 15-15-15 fertilizer was applied in two splits at the rate of 400kg per hectare. The first application was after thinning at 3 weeks after planting, while the second application was at tasseling. Weed control on the plot was done manually using hoes, while Furadan 3G was used for pest control.

Data were collected on days to 50% emergence, days to 50% tasseling, days to 50% silking, ear height, ear weight, plant height at tasseling, 100 seed weight, and grain yield. Data collected from the two years were pooled as there were no significant differences between years, and were subjected to analysis of variance (ANOVA) to detect significant differences between treatment means (Obi, 1986). Fisher's least significant difference (F-LSD) was used for mean separation.

Correlation analysis was also carried out using the Genstat Discovery Edition 3 (Genstat, 2007) to determine the relationship among measured traits.

Table 1: Name, Source and kernel Colour of Twenty maize accessions used for the study

Maize Accessions	Source	Kernel colour
Abiola Taraba	Awka, Ananibra state	Yellow
Agba White	Mbaise, Imo state	White
Oka Akiti	Ibeku. Abia state	White
Oka Asaba	Onitsha. Anambra state	Yellow
Egbuonwa	Mbaise, Imo state	Yellow
Mkpanrnkpa	Obinze. Imo state	Yellow
Nwaudalukpo	Eziobodo. Imo state	Yellow
Nwaduala	Mbaise, Imo state	Yellow
Oka Awaka	Awaka, lmo state	Yellow
Oka Bende	Bende. Abia state	White
Oka Emekuku	Emekuku. Irno state	Yellow
Oka Igala	Nsukka, Enugu state	Yellow
Oka Ike	Obowu, lmo state	Yellow
Oka lkpo	Ndegwu, Imo state	Yellow
Oka Mmanu	Orji, Imo state	Yellow
Oka Nsukka	Nsukka, Enugu state	Yellow
Oka Ohaji	Ohaji Egbema, Imo state	White
Oka Onitsha	Onitsha, Anambra state	Yellow
Oka Uhie	lkeduru, Imo state	Yellow
Ukwuoru	Okigwe,Imo state	Yellow

Results and Discussions

Results in Table 2 show that significant differences exist among the maize accession in the number of days taken to tassel, silk, and number of days from tasseling and silking to maturity. The number of days to tasseling ranged from 35 to 45 days, while days to silking ranged from 39 to 53. The number of days from taseling to maturity, and silking to maturity ranged from 63 to 81, and 60 to 77, respectively. The number of days it took the different accessions to attain physiological maturity are statistically the same (107 to 122 days). No variation exists among the accessions in tasseling–silking interval which ranged from 5-8 days.

Table 2: Effect of Accessions on days from sowing to 50% Tasseling, days to 50% Silking, days to physiological maturity, days from Tasseling to Maturity and Tasseling-silking interval.

Maize Accessions	Days to 50% Tasseling	Days to 50% Silking	Days to maturity	Days from tasseling to maturity	Days from silking to maturity	Tasseling-silking interval	Maturity Rating
Oka Uhie	42.70	50.70	115.00	69.30	62.30	7.00	Interm
Oka Emekuku	44.00	51.70	122.00	78.00	70.30	7.67	late
Nwaudalukpo	37.30	44.30	107.30	70.00	63.00	7.00	Interm
Mkpanmkpa	45.30	51.70	120.70	72.40	66.00	6.00	late
Oka Igala	39.30	45.30	117.70	78.40	72.40	8.67	Interm
Oka Ikpo	36.30	45.00	115.70	69.40	70.70	5.33	Interm
Oka Nsukka	35.00	39.00	109.50	74.30	76.70	5.00	Interm
Oka Awaka	42.30	51.30	111.00	63.70	59.70	6.00	Intemn
Oka Kwuoru	39.30	46.70	109.30	70.00	62.60	7.40	Interm
Oka Ike	41.00	46.70	114.00	73.00	67.30	5.67	Interm
Oka Nwaduala	43.00	52.70	122.00	81.00	61.30	7.33	late
Oka Onisha	40.30	47.70	113.70	73.40	74.30	7.33	Interm
Oka Asaba	37.30	42.70	113.70	66.40	61.00	5.00	Interm
Abiola Taraba	38.30	42.30	111.00	78.70	71.40	7.30	Interm
Agba White	36.30	45.00	112.70	76.40	67.70	8.00	Interm
Oka Bende	35.70	40.30	111.30	75.60	72.40	5.67	Interm
Oka Ohaji	35.00	40.70	115.00	80.00	74.30	6.33	Interm
Oka Akiti	35.00	40.00	111.30	76.30	61.30	6.00	Interm
Egbuonwa	40.00	48.00	115.70	75.70	67.70	8.00	Interm
Oka Mmanu	37.00	48.70	108.00	71.00	59.30	8.67	Interm
LSD (p =0.05)	5.94	9.46	-	8.96	18.70	-	
C.V. (%)	8.87	12.63	15.28	10.70	9.60	16.90	

The means of plant height of the accession studied were statistically similar; while the Ear height, Ear weight, 100-seed weight, and grain yield indicate significant variations (Table 3). The height ranged from 74.30cm to 107cm; while the ear weight, 100-seed weight, and grain yield ranged from 11.87 g to 134.90g, 11.61g to 39.18, and 1.38t to 3.21t respectively. This implies that the accessions could be discriminated for superior performance and that selection could be based on its inherent ability to tolerate the prevailing abiotic factors within the period of growth and development. The significant differences observed indicate the existence of substantial variability among the accessions hence a scope for improvement through selection.

Based on Obi (1991) and Babu-Apraku *et al.(*2001) maturity ratings in maize, seventeen of the twenty accessions studied are classified as medium maturing, while three accessions, Oka Emekuku, Mkpanmkpa, and Nwaduala are classified late maturing when using days from planting to physiological maturity as the indices for maturity.

Table 3: Effect of Accessions on Plant height (cm), Ear height (cm), Ear weight, (g), Hundred seed weight (g) and **Grain yield (tons/ha).**

Maize Accessions	**Plant height (cm)**	**Ear height (cm)**	**Ear weight (g)**	**100-seed weight (g)**	**Grain yield (t/ha)**
Oka Uhie	1.76	90.30	130.60	18.12	2.33
Oka Emekuku	1.58	96.00	I29.80	21.35	2.35
NwaudaIukpo	1.44	92.30	106. 10	14.33	1.65
Mkpanmkpa	1.66	85.70	134.90	15.71	3.21
Oka Igala	1.47	93.70	68.68	21.01	1.58
Oka Ikpo	1.75	100.30	128.90	23.34	2.53
OkaNsukka	1.54	100.70	127.60	18.50	1.81
OkaAwaka	1.56	107.00	48.20	18.80	2.84
Ukwuoru	1.77	86.00	75.90	16.68	1.69
Oka Ike	1.65	93.70	72.60	17.09	2.53
Nwaduala	1.64	98.30	95.70	16.81	2.58
Oka Onitsha	1.93	90.00	56.56	17.54	1.87
Oka Asaba	1.99	98.30	120.90	20.17	2.40
Abiola Taraba	1.54	90.70	56.50	24.09	2.78
Agba White	1.29	87.00	29.25	17.76	1.49
Oka Bende	1.44	92.30	125.10	30.18	2.55
Oka Ohaji	1.61	91.70	11.87	11.61	2.28
Oka Akiti	1.52	74.30	32.90	17.82	1.38
Egbuonwa	1.57	76.00	132.60	21.67	2.51
Oka Mmanu	1.95	77.30	96.70	14.36	2.88
LSD (p=0.05)	-	14.30	31.94	6.31	0.89
C.V. (%)	18.09	20.82	21.73	15.23	24.29

From the correlation studies shown on Table 4, positive correlations exist between days to physiological maturity and days to 50% tasseling, days to 50% silking, ear weight, which possibly indicate that the same gene controls the traits. Consequently, using number of days to tasseling and silking as indices for maturity, maize cultivars could be classified as follows:
Tasseling time; late maturing – 43 days and above, Intermediate – 35 to 42 days, and Early maturing – less than 30 days.
Silking time; late maturing – 51 days and above, Intermediate – 39 to 50 days, and Early maturing – less than 38 days. This implies that either tasseling or silking could to a reasonable extent be used to estimate maturity in maize selection. Significant positive correlation was also recorded between days to 50% silking and days to 50% tasseling indicating that accessions that tasseled early also silked early. Plant breeders are interested in pollen-silk synchronization since large gap between pollination and silking could lead to low kernel setting and hence reduced grain yield.
The linear correlation coefficients (r) among other traits as shown in Table 4 indicate a significant positive correlations between grain yield and hundred seed weight (r=0.274*), ear weight (0.388*), and also between hundred seed weight and plant height (r=0.372**); and between ear weight and days to physiological maturity (r=0.333**). This indicates that the traits have significant genetic and statistical linkage with each other and for effective selection of grain yield, traits such as seed weight and ear weight could be used to determine superior accessions. It also suggest the possibility of achieving simultaneous improvement of the traits since selection for one of such traits should naturally result in progress for all positively correlated traits. Ear weight and seed weight are important yield parameter, which could significantly contribute to the grain yield and ultimately total grain production. This result is in line with the results of Eleweanya et al. (2005) who reported a positive correlation among the parameters. Plant height is negatively correlated with days to physiological maturity (r = -0.11) and days to 50% tasseling (r = -0.155). Days to 50% tasseling also had a negative correlation with ear height (r = -0.008).

Table 4: Correlation coefficients among yield and yield related traits in the maize accessions

	DPM	GY(t/ha)	EH(cm)	DT	PHT(cm)	DS	EWT(g)	HSW
DPM	1							
GY(t/ha)	0.077	1						
EH (cm)	0.116	0.148	1					
DT	0.220	0.122	-0.008	1				
PHT (cm)	-0.111	0.140	0.019	-0.155	1			
SD	0.211	0.058	0.044	0.539**	0.031	1		
EWT (g)	0.333**	0.388**	0.092	0.192	0.289*	-0.210	1	
HSW	0.187	0.274*	0.096	-0.192	0.372**	-0.058	394**	1

***=significant at 5% level probability and **=significant at 1% level of probability**
(DPM= days of physiological maturity, DT= days to 50% tasseling, DS=days to 50% silking, PHT= Plant height at tasseling, EH= ear height, EWT = ear weight, GY= Grain yield, HSW = 100-seed weight).

Summary and Conclusion

The aim of this research was to study the maturity of maize accessions and their genetic correlation among various quantitative traits.

Significant variations exist among the maize accessions in ear height, ear weight, 100-seed weight, grain yield, number of days to tasseling, number of days to silking, and number of days from tasseling and silking to maturity, implying that the accessions could be discriminated for superior performance.

Significant positive correlation was recorded between grain yield, and 100-seed weight, ear weight, and between ear weight and days to physiological maturity.

Also, positive correlation was found between days to physiological maturity and days to tasseling, days to silking, ear weight. Silking and tasseling time could therefore be used to estimate maturity time. Seventeen of the twenty accessions studied were found to be intermediate in maturity, while three accessions were classified as late maturing.

References

Ahmed B. I. and A. U. Yusuf. (2007). Host-plant resistance: A viable non - chemical and environmentally friendly strategy of controlling stored products pests-a review. Emir. J. Food Agric. 19(1): 01-12

Babu-Apraku B., M. Oyekunle, K. Obeng Auti, A.S. Osuman, S.G. Ado, N. Coulibay, C.G. Yallou, M.Abdulai, G.A. Boakyewaa and A. Didjeira (2001). Performance of Extra-early maize cultivars based on GGE biplot and AMMI analysis. Journal of Agricultural science: 1-11 doi: 10. 1017/500218596110000761

Baker R. (1973). Black Layer Development, Word Farming 15:14-19.

Devries, J., and Toenniessen, G. (2010). Securing the Harvest Biotechnology Breeding and seed System for African crops. CAB International, New York.

Eleweanya, N.P., M.I. Uguru and E.E. Ene-Obong. (2005). Correlation and path coefficient analysis of grain yield related characters in maize (*Zea mays* L.) under umudike condtitions of south eastern Nigeria. Agro. Sci. 4 (1):24-28.

Eshett E.T (1993)- Wetlands and Ecotones Studies on Land Water. National Institution of Ecology. New Delhi and International Scientific Publication, New Delhi pp 232-234.

Fakorede MAB, Opeke BO (1985). Weather factors affecting the response of maize to planting dates in tropical rain forest location. Exp. Agric. 21: 31-40.

Genstat (2007), Genstat for windows, Discovery, 3rd edn. Laves, agricultural Trust, Rothamsted experimental station, UK.

Hidayatullah, I.H. Khalil, G. Hassan, Iltafullah and H. Rahman. (2006). Performance of local and exotic inbred lines of maize under agro-ecological conditions of Peshawar. Sarhad J. Agric. 22 (3): 409-414.

Ibarbia, E.A. and Lambeth, V.N. (1969) Inheritance of soluble solids in a large/small-fruited tomato cross. J. Am. Soc. Hortic. Sci. 94: 496-498.

Miti, Pangirayi tongoona and John Derera(2010) S_1 selection of local maize landraces for low soil Nitrogen tolerance in Zambia, African journal of Plant science, Vol. 4(3)Pp. 067-081

Moyin-Jesu E. I. (2010). Comparative evaluation of modified neem leaf, wood ash and neem leaf extracts for seed treatment and pest control in maize (*Zea mays* L.). Emir. J. Food Agric. 22(1): 37-45.

Obi, I.U. (1986). Statistical methods of detecting differences between treatment means and research methodology issues in laboratory and field experiments 2nd ed. Published by AP

Express publishers Limited, Nsukka, Nigeria, 117pp.

Obi, I.U. (1991). MAIZE its Agronomy, Diseases, Pests and food values. Published by Optimal compular solutions Ltd, Enugu. 206pp.

Poehlman, J.M. (1977). Breeding Field Crops. 2nd. The AVI Publish. Co. Inc. Westport, Connecticut.

Ritchie S.W, J.J. Hanway and G.O. Benson (1997). How can Plant Develop? (p.48) Iowa State.

Thjis-Tollenaar (2012), Corn maturity and heat units, Plant Agriculture, University of Guelph.