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GENETIC VARIATION, HERITABILITY AND GENETIC ADVANCE FOR YIELD AND AGRONOMIC TRAITS ASSOCIATION OF SOME LOW NITROGEN TOLORANCE MAIZE VARIETIES IN THE TROPICS

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ABSTRACT

Ten open pollinated low nitrogen tolerance maize genotypes were tested using a randomize complete block design at Landmark University Teaching and Research farm in 2016 to 2017 cropping season to estimate the genetic variance, heritability, and expected genetic advance of 12 maize population for grain yield and its component characters. The 10 low N maize populations and 2 checks were evaluated under two different nitrogen regimes 90kg and 30kg of N/ha classified as high N and low N respectively. The study revealed lower phenotypic variances (σ2p) and PCVs relative to genetic variances (σ2g) and GCVs for all the studied characters, suggesting the low influence of environmental factors in the expression of these characters. High degree of genotypic coefficient and phenotypic coefficient of variance, heritability and genetic advance were recorded for grain yield, anthesis silk interval, husk cover, plant height, ear height, plant aspect, days to silking and days to pollen shed. This result suggests that the parameters tested were under the control of additive gene action; and that standard selection protocol may therefore be well appropriate for the improvement of these characters. Moreover, selection of these traits with high degrees of heritability base are predicted to be reliable across different environment in the tropics

Lowest value of interval between days to anthesis and silk (ASI) was obtained by BR 9928-DMRSR LN C1. This maize genotypes is a better candidate for the future maize improvement programmes in quest for the development of drought tolerance maize variety in the tropic.

Highest maize grain yield were recorded by varieties TZLCOM1C6LNC I (6.19 t/ha) and Sint Marzocalarga (5.26 t/ha) under high N and low N respectively. These two maize genotypes can therefore be suggested for the future maize grain yield improvement programmes in the tropic.

Keywords: Heritability, Genetic-Variation Low-Nitrogen, Tolorance, Genetic-Advance.

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1. INTRODUCTION

The extent of genetic variation present in base population of any crop variety is an important tools that can be exploited by plant breeders for yield improvement (Idahosa *et al*, 2010.) Adequate variation in any crop population provides options from which selections are made for improvement and possible hybridizations. Genotypic correlations had been used as an effective tool to determine the relationships among agronomic traits in genetic diverse population for enhanced progress in crop improvement.

Heritability of a trait is an indicator of the extent of genetic component for the expression of a particular trait (Chopra, 2000). Moreover, heritability also predicts the reliability of phenotypic variability in the selection programme and hence determines its stability across different environment (Hamdi, 1992). Estimate of heritability assists breeders to allocate resources necessary to effectively select for desired traits and to achieve maximum genetic gain faster with limited resources (Smalley *et al.*, 2004).

Genetic advance is another breeding tool that explains the extent of genetic gain or progress made in a character under a particular selection pressure. High genetic advance coupled with high heritability estimates offers the most suitable condition for selection. It also indicates the presence of additive genes in the tested trait and further suggest the reliability of crop improvement of such traits through standard selection protocol. Continuous improvement of maize grain yield per hectare is imperative for ever increase for grains in the world. This can be achieved through effective selection of suitable parent materials of significant genetic variability that can be included in future breeding programmes. Low soil nitrogen has been reported as one of the most wide spread problems among small-scale farmers in the tropics (Betràn *et al.*, 2003; Zaidi *et al.*, 2003). An increase in population pressure has intensified the use of land which has resulted in a depletion in the nutrient and organic matter in the soil and consequently decreased crop yield. Intensification of land use is only feasible if the nutrients are replenished when nutrients are depleted due to cultivation. The quantity of inorganic fertilizer available for indigenous Farmers in sub-saharan African are highly limited and far below standard recommended levels, and the cost prices mostly are unaffordable by many farmers. In Nigeria, the average rates of nitrogen fertilizer use are about 12 kg N/ha on arable land, while the figures are lower for most of the West African countries (FAO, 1992). Farmers in the savanna zone of northern Nigeria require greater amounts of nitrogen fertilizer for the production of their crops compare with those in the forest zone (Kling *et al.*, 1996). Identification and selection of low nitrogen tolerance maize varieties is giant breakthrough that will alleviate the farmers of one of their incessant production bottleneck resulted from low nitrogen soil condition in the tropic (Pollmer *et al*., 1979). There is a continuous effort by the plant breeder in the tropic to select for high yielding maize varieties under low Nitrogen environment conditions and consequently advance breeding progress. (Banziger et al.,1997).

This study was therefore carried out to (i) assess the agronomic performance of ten (10) Low-nitrogen tolerance maize varieties under low and high-N environment conditions. (ii) estimate the genetic variation, genetic associations, heritability and expected genetic advance in the low nitrogen tolerance maize varieties.

2. MATERIALS AND METHOD

The field experiment was conducted at the Teaching and Research Farm of Landmark University, Omu-Aran, Kwara State (Latitude 8^0 9^0 0" N and Longitude 5^0 61^0 0" E) located at the Southern Guinea Savannah Zone of Nigeria in 2015 and 2016. The area has maximum temperature of 36^0c to 33^0c and the minimum temperature of 28^0c to 22^0c. The humidity of the area is high (47-43%) all year round except in January when the dry wind blows from the north. It has an annual rainfall pattern which extends between the months of April and October with average annual rainfall of between 600mm – 1500mm. The peak rainfall is in May – June and September – October while the dry season is between November and March. The plant materials used in this study comprised 10 open-pollinated varieties (OPVs) of maize which were developed for grain yield and adaptation to low-N environment at the International Institute of Tropical Agriculture (IITA), Ibadan and two checks. They are late /Intermediate maturing white or yellow grained cultivars with maturity period of ranges from 90 - 120 days. Table 1 shows the phenotypic characteristic of the 12 maize varieties used in the study. The 12 genetic materials were evaluated under two different levels of nitrogen application (30kgha^{-1} and 90kgha^{-1}) which were denoted as high and low N environments respectively. In all evaluations, two row plots were used. Each row was 6m in length, spaced at 0.75m between rows 0.25m within rows with four replications to give a population density of approximately 53,333 plants per hectare. Observed cultural practices included pre-emergence spray of gramozone and primextra for weed control supplemented with hand weeding as necessary during the season.

Data were collected on plant stand, days to anthesis, days to silking, anthesis –silking interval, plant height, ear height, root lodging, stalk lodging, husk cover, plants harvested, plant aspect, ear aspect, ear rot, ears harvested , field weight, moisture The percent grain moisture was determined using a Dickey-John moisture tester (Model 14998, Dickey-John Corporation, Auburn, Alabama). Grain yield per plot was obtained as grain weight per plot adjusted to 15% moisture and converted to tons /ha.

All data collected were subjected to analysis of variance (ANOVA), Pertinent means were further separate by the use of the Least Significant Difference (LSD) test according to Steel and Torrie (1980). Further analyses conducted includes genetic variation, heritability and genetic advance for yield traits and agronomic traits association

Phenotypic and genotypic variance, genotypic and phenotypic coefficients of variation were estimated based on formula by Syukur *et al.,* (2012)

$\sigma^2 g = [(MSg) – (MSe)] / r$

$\sigma^2 P = [\sigma^2 g + (\sigma^2 e/r)]$, where: σ^2g = Genotypic variance; σ^2p = Phenotypic variance;

σ^2e = environmental variance (error mean square from the analysis of variance); MSG = mean square of genotypes;

MSE = error mean square; r = number of replications.

$PCV(\%)\frac{\sqrt{\delta^2 p}}{x} \times 100$ s number of replication.

The mean values were used for genetic analyses to determine phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV).

$$GCV(\%) = \frac{\sqrt{\delta^2 g}}{x} \times 100$$

where: $\delta^2 g$ = genotypic variance, $\delta^2 p$ = phenotypic variance and x = sample mean.

GCV and PCV values are categorized as low when less than 10%, moderate at 10-20%, and high when greater than 20% (Deshmukh *et al.,* 1986).

Broad sense heritability (h^2) estimate of each trait was computed according to the procedure outlined by Falconer as: Heritability

$$(h^2) = \frac{\delta^2 g}{\delta^2 p}$$

Where: $\delta^2 g$ = genotypic variance and

$\delta^2 p$ = phenotypic variance.

Genetic advance (GA) The expected genetic advance for the different character under selection was estimated as suggested by Johnson *et al.,* (1955)

$GA = K (\sigma_p) h^2$, where: K = the selection differential (K = 2.06 at 5% selection intensity);

σ_P = the phenotypic standard deviation of the character;h^2 = broad sense heritability

Soil analysis were also conducted to determine the initial status of plant nutrient in the soil used for the study, which is present in Table 2.

Table 1: Soil physical and chemical properties prior to planting (0-15cm)

Parameter	Value
Particle size	
Sand (%)	76.12
Silt (%)	12
Clay (%)	11.88
Textural class	Lateritic
pH (H_2O) 1:1	5.25
Total Nitrogen (%)	0.16
Organic Carbon (%)	1.88
Organic Matter (%)	3.24
Exchangeable bases	
K (cmol/kg)	0.23
Na (cmol/kg)	0.66
Ca (cmol/kg)	3.97
Mg (cmol/kg)	1.32
Al^+H (cmol/kg)	0.07
ECEC (cmol/kg)	6.25
Available Phosphorus (mg/kg)	21.12

The pre-planting soil analysis is as shown in **Table 1**. The pH of the soil was slightly acidic, the Nitrogen content of the soil was very low, the available Phosphorus was high, and the exchangeable K was at moderate while the exchangeable Na, Ca, and Mg are all suitable. The organic Carbon and Organic matter are adequate. The soil is highly sandy with relatively low values of both silt and clay; hence the textural class is Sandy

3. RESULT AND DISCUSSION

There were non-significant variation for plant height among the 12 maize populations tested under high N environmental conditions (Table 2) which suggests that high nitrogen level did not differential influence the maize genotypes for plant height. However, variation for ear height were significantly differ among the maize genotypes under the same nitrogen regime. Highest and significant ear height observed under high N relative low N environmental conditions, indicates that higher level of nitrogen fertilizer application favors ear height.. Differential response of the 12 maize genotypes for ear height under higher level of nitrogen fertilizer application revealed the existence of sufficient variation in genetic makeup that condition ear height among the maize population under the nitrogen regime. Thus the maize breeders have better chances for the improvement of this traits under the application of the recommended level of nitrogen fertilizer in future breeding programs. Contrary to what was obtained under high N environment, variation for plant height was highly significant differently under low N environment, higher and significant plant height were obtained under low N compare to high N regime (Table 4). This is an indication that low N environment seemed to favor plant height relative to high N environment conditions among these low N tolerance maize populations. It indicates that this maize population can tolerate low N condition for the production of better vegetative growth in the tropics. Response to stem lodging varied significantly under both low N and high N conditions (Table 3 & 4). However, variation for root lodging was only significant under low N application environment. The result of this study therefore revealed that the tested maize genotypes responded differentially to root and stem lodging under low N environmental conditions. Thus these maize genotypes are good candidates for the development of tolerance to root and stem lodging in the low nitrogen condition that characterized the tropical soil. All the tested maize genotypes were not significantly different in the ranking for phenotypic appearance under different levels of nitrogen application regimes except three. This suggests that this trait is not influenced by low or high levels of nitrogen fertilizer application. Variation for husk cover among the maize genotypes were not significantly different under high N environment, however, significant variation for the same trait were observed among the maize populations under low N condition. There is therefore better opportunity for the improvement of this trait under low environmental condition. Variation for days to silk and pollen shed were not significantly different among the tested maize genotypes under the two nitrogen regimes. However, variation among the maize population were significantly different for the interval between anthesis and days to silk (ASI) under low nitrogen application regime. This maize population can therefore be suggested for the development of drought tolerance maize hybrids in the tropic. Variation for maize grain yield were highly significantly different among the maize populations evaluated under low N, while it was not under high N condition. There is therefore better opportunity for the development of maize hybrid for grain yield among this population under low N relative to high N regime in the future maize hybrid development programme in the tropic. Highest maize grain yield were recorded by varieties TZLCOM1C6LNC I (6.19 t/ha) and Sint Marzocalarga (5.26 t/ha) under high N and low N respectively. These two maize candidates can therefore be suggested to be included in the future maize improvement programmes in the tropic characterized with low nitrogen soil.

Mean performance of all tested traits were significantly different under low N environment for all the traits studied except, ear height, days to silking and days to pollen shed. Similarly, mean for all the traits evaluated under high N environment were significantly different from each other, except for plant height, root lodging,husk cover, days to silking and days to pollen shed (Table 2 & 3). Varieties BR 99 TZL Comp 4 DMSRSR, ACR 9931 DMRSR LN SYN and ACR 97 TZL Comp 1-W LN C1 obtained higher plant height (209.00cm, 208.18 cm, and 191.50) respectively under low N environment relatively to high N environment. Suggested that maize plant height among these maize populations were not determined by the levels of nitrogen fertilizer applied. However, ACR 9931 DMRSR LN SYN F2 recorded the highest but non-significant ear height under the low N environment. LA POSTA SEQUIA C6 and ACR 97 TZL Comp 1-W LN C1 were observed to be more susceptible to lodging compare to other maize population evaluated under high N environment, while BR 99 TZL Comp 4 DMSRSR was identified to be most susceptible to root and stem lodging under low N environmental conditions. BR 99 TZL Comp 4 DMSRSR ranked first in phenotypic appearance among other varieties, while BR 9928-DMRSR LN C1 ranked second under both high and low N environments. This suggest that the phenotypic appearance of these two varieties do not depend on the level of nitrogen present in the soil. TZL COMP 1 C6 LN C1, Sint Marzoca Larga and BR 99 TZL Comp 4 DMSRSR had better husk cover compare to other maize genotypes under higher nitrogen application regime, while LA POSTA SEQUIA C6 and BR 99 TZL Comp 4 DMSRSR ranked highest for good husk cover under low N environment. The aforementioned maize genotypes are better candidates that can be selected for future improvement programmes for the development of good husk cover under low and high-N environments. There were non-significant difference for days to silk among the maize population under the two nitrogen environments. Extrusion of silk was late under low and high N environment for variety LNTP-W C4 and TZPB Prol C4. However, day to silk was earliest in varieties Sint Marzoca Larga under low N environment. Variation due to days to pollen shed was not significantly different among the 12 varieties, however, days to anthesis was delayed in varieties TZPB Prol C4 relative to other varieties under low N conditions. Higher values of interval between days to anthesis and silk (ASI) were observed among LA POSTA SEQUIA C6 and ACR 9931 DMRSR LN Syn while the least value was recorded by BR 9928-DMRSR LN C1. The latter maize genotypes is a good candidate that can be selected for future maize improvement programmes for the development of drought tolerance maize variety.

Table 2 Mean performance of the 10 low-N maize populations and 2 checks under High N (90kg/ha) environments for grain yield and related traits

VARIETIES	PLHT. Cm	EHT. Cm	RL. Cm	PASP. Cm	HUSK. Cm	SL. (1-5)	DSK (1-5)	DPS Day	ASI day	GY t/ha
LNTP-Y C7	173.00a	72.68cd	1.68a	2.68ab	3.00a	2.68ab	65.50a	64.50a	1.00bc	3.48ab
LNTP-W C4	163.83a	78.23bcd	2.00a	3.00ab	2.33a	2.00bc	66.50a	65.00a	1.50bc	2.66b
TZPB Prol C4	170.50a	91.00abc	2.00a	2.33ab	2.33a	1.68bc	66.50a	65.25a	0.75c	3.90ab
BR 9928-DMRSRLN C1	176.18a	80.83abcd	2.00a	3.00ab	2.00a	1.68bc	65.75a	63.75a	2.00ab	3.48ab
TZL COMP 1 C6 LN C1	154.18a	78.33bcd	2.00a	2.68ab	3.33a	1.33c	65.50a	64.25a	1.25bc	6.19ab
LA POSTA SEQUIA C6	178.50a	59.18d	2.68a	3.00ab	2.33a	3.33a	67.50a	64.75a	2.75a	4.86ab
Sint Marzoca Larga	172.33a	86.50abc	2.00a	3.00ab	3.33a	2.33abc	66.00a	64.25a	1.75abc	4.56ab
BR99TZLComp4 DMSRSR	180.33a	105.83a	2.00a	3.68a	3.33a	2.33abc	66.00a	64.75a	1.25bc	4.50ab
Acr97TZLComp1-W LN C1	191.33a	97.00abc	2.68a	3.00ab	2.00a	2.00bc	65.00a	63.75a	1.25bc	4.90ab
Acr9931DMRSR LN Syn	186.00a	103.83a	2.00a	3.00ab	2.33a	1.68bc	66.25a	63.50a	2.75a	5.47ab
CHECK1	189.50a	90.83abc	1.68a	2.00b	2.00a	1.33c	66.00a	65.25a	0.75bc	4.95ab
CHECK 2	194.18a	98.33ab	2.00a	2.00b	3.00a	2.33abc	66.25a	64.50a	2.00ab	6.74a

- PLH = Plant Height, EH = Ear height, RL = Root Lodging, PASP = Plant Aspect,
- Husk = Husk Cover. DSK = days to silk, DPS = days to pollen shed, ASI = anthesis silking interval, GY = grain yield
- Numbers with Same alphabet letters are not Significantly different.

Table 3 Mean performance of the 10 low-N maize populations and 2 checks under Low- N (30kg/ha) environments for grain yield and related traits

VARIETIES	PLH Cm	EH. Cm	RL. Cm	PASP. Cm	HUSK. (1-5)	SL. (1-5)	DSk Day	DPS. Day	ASI Days	GY t/ha
LNTP-Y C7	172.33cd	81.83a	1.68bc	2.68ab	2.00abc	2.33ab	66.50a	65.00a	1.50a	4.56abc
LNTP-W C4	175.68abcd	75.68a	2.00abc	2.33ab	2.68ab	2.33ab	68.00a	66.25a	1.75a	1.96d
TZPB Prol C4	177.68abcd	80.18a	1.68bc	2.33ab	1.68bc	1.33b	67.50a	66.50a	1.00a	3.59bcd
BR 9928-DMRSR LN C1	162.00d	77.00a	2.33abc	3.33a	2.00abc	1.68b	66.00a	64.00a	2.00a	2.84cd
TZL COMP 1 C6 LN C1	178.33abcd	79.00a	2.33abc	2.33ab	2.33ab	1.68b	66.00a	64.75a	1.25a	3.25cd
LA POSTA SEQUIA C6	167.83cd	92.00a	3.33a	2.33ab	3.00a	2.33ab	67.25a	66.00a	1.25a	3.88bcd
Sint Marzoca Larga	173.68bcd	78.50a	2.00abc	3.00ab	2.68ab	3.00a	67.25a	65.25a	2.00a	5.26abc
BR99TZLComp4DMSRSR	209.00a	95.33a	2.68abc	3.68a	3.00a	2.33ab	66.75a	64.25a	1.50a	3.81bcd
Acr97TZLComp1-WLNC1	191.50abcd	91.00a	3.00ab	1.68b	2.68ab	1.33b	65.75a	64.25a	1.50a	4.60abc
Acr 9931 DMRSR LN Syn	208.18ab	96.50a	1.33c	3.00ab	1.00c	1.68b	65.75a	64.25a	1.50a	5.21abc
CHECK1	182.83abcd	86.50a	2.33abc	2.33ab	2.00abc	1.33b	67.00a	65.50a	1.50a	5.87ab
CHECK 2	200.00abc	95.18a	1.68bc	1.68b	2.33ab	2.33ab	67.25a	65.00a	2.25a	6.85a

- PLH = Plant Height, EH = Ear height, RL = Root Lodging, PASP = Plant Aspect,
- Husk = Husk Cover. DSK = days to silk, DPS = days to pollen shed, ASI = anthesis silking interval, GY = grain yield
- Numbers with Same alphabet letters are not Significantly different.

Phenotypic coefficient of variation (PCV) and Genotypic coefficient of variation (GCV) are useful tools for comparing the relative amount of phenotypic and genotypic variations present in a particular trait among maize populations, and good for predicting the scope of improvement through selection protocol. Reliability of selection in a breeding programme is determined by the magnitude of GCV in a population. A high proportion GCV to the PCV is desirable in breeding works as it show that the environment does not have high influence on the trait. The results (Table 4) revealed that phenotypic variances (σ^2p) and PCVs were lower than genetic variances (σ^2g) and GCVs for all the characters measured, suggesting that the least influence of environment in the expression of these characters. Similar results have also been reported by Bello. *et al.*, 2012. who also observed high values of PCV and GCV in Anthesis-silk interval (ASI) followed by grain yield, husk cover and plant aspect. This observation did not only revealed that the standard selection procedure will be effective for the improvement of these traits, it also suggests the existence of substantial variability among the maize genotypes, which further ensure ample scope for their improvement through selection. However, very low values of PCV and GCV recorded for days to 50% pollen shed, days to 50% silking and plant height showed the existed of low variability among the varieties for these characters. Introgression of genes for these traits is therefore necessary for their improvements among these maize genotypes.

Assessment of the extent of heritability in a crop population is another important tool in breeding programs in quest for elite genotypes from different genetic population. High heritability therefore is required for the reliability of the desire trait in a selection programs. Heritability is hence classified as low (below 30%), medium (30-60%) and high (above 60%) (Reddy *et al.,* 2013). The characters studied in this present investigation (Table 4) expressed medium to high heritability estimates ranging from 39-88% under low nitrogen environment. Among the yield related characters, higher broad sense heritability was recorded for anthesis silk interval (88%), ear height (84%), days to 50% pollen shed (78%), days to 50% silking (78%),and plant height (72%) relative to other traits. It suggests that the selection of these traits will be stable and reliable across different environments. Genotypes that expressed these heritability values are good candidates for the development of adaptation to different ecological zone. However medium heritability was recorded in plant aspect (55), root lodging (51), stalk lodging (46), husk cover (45) and grain yield which had the lowest heritability (39) under low N environment. This phenomenon revealed that the selection of these maize populations for grain under low N environment is influenced by environmental factors. Selection protocol may therefore be considerably difficult or virtually impractical for grain yield under low N conditions due to the masking effect of the environment. Similar results have been reported by Tewari (1999); Rai *et al.,* (2000); Rama Kant *et al.,* 2005; Reddy *et al,* 2013). However, plant breeder, may make his selection for those low N maize varieties with high heritability percentage safe on the basis of phenotypic expression of tho characters in the individual plant by adopting simple selection methods (Reddy *et al.,* 2013).

The genetic advance is a useful indicator of the progress that can be expected as result of exercising selection on the pertinent population (Reddy *et al,* 2013). Heritability coupled with genetic advance would give a more reliable index of selection value (Johnson *et al*., 1955). In the present study high genetic advance was recorded for plant height, ear height, and grain yield under low N environment. Higher heritability and genetic advance were recorded by plant and ear height under the same environment. Swamy *et al.,* (1971) also reported higher magnitude of broad sense heritability coupled with higher genetic advance in grain yield ,plant height, and days to 50 % silking. The author concluded that it evidence that these plant parameters were under the control of additive genetic effects.

This therefore implies that standard selection protocols would be effective in breeding strategy aimed at improving these traits (Edwards *et al.,* 1976)

Table 4 Estimates of phenotypic (δ2p), genetic (δ2g) variance, phenotypic (PCV) and genotypic (GCV) ,heritability (H), and genetic advance (GA) of 10 low-N Maize Populations and the 2 Checks under Low-N and High-N (30kg/Ha and 90kg/Ha N) Environments for 10 Traits

TRAIT	δ^2_g	δ^{2p}	H^2	PCV	GCV	GA
Days to Pollen Shed (LN)	2.82	3.6	78	2.92	2.58	5.78
Days to Pollen Shed (HN)	2.58	3.27	79	2.81	2.49	5.32
Days to Silking (LN)	2.48	3.16	78	2.66	2.36	7.29
Days to Silking (HN)	2.32	2.81	83	2.54	2.31	4.8
Grain Yield (LN)	1.33	3.45	39	43.1	26.76	2.77
Grain Yield (HN)	3.69	5.26	7	49.43	41.4	7.58
Anthesis-Silk-Interval(LN)	1.14	1.3	88	72.16	67.58	3.11
Anthesis-Silk-Interval(HN)	0.09	0.56	16	47.36	18.99	1.34
Husk Cover (LN)	0.35	0.77	45	38.49	25.95	0.71
Husk Cover (HN)	0.47	0.83	57	34.91	26.27	0.97
Plant Height(LN)	428.4	597.65	72	13.34	11.29	879.02
Plant Height(HN)	293.21	587.25	5	13.65	9.65	879.02
Ear Height(LN)	391.25	467.46	84	25.22	23.08	808.89
Ear Height(HN)	130.57	359.66	36	21.83	13.15	266.72
Plant Aspect (LN)	0.58	1.05	55	40.18	29.87	1.19
Plant Aspect (HN)	0.49	0.77	64	31.56	25.18	1.02
Root Lodging(LN)	0.44	0.87	51	42.59	30.29	0.91
Root Lodging(HN)	0.67	0.79	85	43.15	39.73	1.38
Stalk Lodging(LN)	0.31	0.67	46	41.55	27.59	0.63
Stalk Lodging(HN)	0.32	0.73	44	41.68	30.29	0.66

GCV = Genetic coefficient of variance, PCV = phenotypic coefficient of variance, GA = genetic advance, δ^2g- = genotypic variance, δ^2p = phenotypic variance and H^2 heritability

The knowledge of correlation existing between different plant traits help the breeders to understand how the improvement of one trait cant influence the other, and how they finally affect grain yield.

Positive correlation were observed among plant height, root lodging, stalk lodging, and crop harvested, evidence that increase in plant height will result in an increase in the values of these traits. However, plant height was negative correlated with plant aspect, husk cover, grain yield, days to silking, and anthesis silk interval , which suggests that an increase in plant height will result in a decrease the above parameters.

Positive correlation was also observed among ear height, root lodging, plant aspect, husk cover, grain yield, moisture content, days to silk and anthesis silk interval (Table 5). It depicts that root lodging and grain yield are positively influence by ear height. Thus high ear height favors root lodging, and increase in grain yield.. Breeder should therefore aim at improving maize plant for lower ear height and therefore reduce maize plant susceptibility to stem and root lodging most especially in the savanna zone that is prone to strong wind with less wind breaker. Relationship between ear height and days to silk was significantly positive, this an indication that higher ear height encourages longer days to silk extrusion. On the other hand, lower ear height hasten days to silking. Root lodging and stem lodging are negatively and significantly correlated, this is an indication that the two do not occur simultaneously. Positive and significant relationship existing between moisture content and husk cover suggest better husk cover favors higher moisture content. However, positive and significant correlation existing between moisture content and days to silk revealed that higher moisture content lengthen days to extrusion of silk. The study also revealed that days to silk widen the interval between days to anthesis and silking (ASI).

Table 5 Correlation analysis for Plant Characteristics Of 10 Low-N Maize Varieties and two Checks

	EHT	RL	PASP	HUSK	SL	CHAR	GY	Moist	DYS	ASI
PLH	.115	.059	-.095	-.250*	.239*	.334**	122	-.283**	-.225*	-.074
EHT		.102	.214*	.051	105	-.102	.046	.337**	.294**	.012
RL			.106	.076	-.228*	-.186	.125	-.095	-.085	-.007
PASP				.189	-.183	-.190	.077	.095	.115	-.003
HUSK					.003	-.008	-.007	.254*	.186	.124
SL						.852**	-.374**	-.346**	-.329**	.023
CHAR							.312**	-.255*	-.310**	.108
GY								.208*	200	.014
MOIST									.830**	.217*
DYS										-.351**
ASI										

PLH = plant height, EHT = Ear height, RL = root lodging. PASP = plant aspect, HUSK = husk cover, SL= stalk lodging, CHAR = crop harvested, GY = grain yield, DYSK = days to silk, ASI =anthesis silk interval, * Correlation is significant at the 0.05 while ** Correlation is significant at the 0.01 .

4. CONCLUSION

High degree of genotypic coefficient and phenotypic coefficient of variance, heritability and genetic advance were recorded for grain yield, anthesis silk interval, husk cover, plant height, ear height, plant aspect, days to silking and days to pollen shed. This result suggests that the parameters tested were under the control of additive gene action; and that standard selection protocol may therefore be well appropriate for the improvement of these characters. Moreover, selection of those traits with high degrees of heritability predict their reliability across different environments in the tropics.

Lowest value of interval between days to anthesis and silk (ASI) was obtained by BR 9928-DMRSR LN C1. This maize genotypes can therefore be suggested for the future maize improvement programmes in quest for the development of drought tolerance maize variety in the tropic.

REFERENCE

[1] Bänziger, M.., Lafitte, H.R..,G.O. Edmeades. (1995). Intergenotypic competition during evaluation of maize progenies under limited and adequate N supply.Field Crops Research 44: 25-31.

[2] Bello, O. B.,. Ige, S.A., Azeez, M.A., Afolabi, M.S., Abdul-maliq, S.Y., Mahamood, J., (2012). Heritability and genetic advance for grain yield and its component character in Maize (Zea mays L.). International Journal of Plant Research, 2: 138–145. DOI: 10.5923/j.plant.20120205.01

[3] Betran, F., Ribaut, J., Beck, D., De Leon, D. G. (2000). Genetic diversity, specific combining ability, and heterosis in tropical maize under stress and non-stress environments. Crop Science,43: 797-806.

[4] Chopra, V.L., (2000). Plant breeding – Theory and practice 2nd ed. Oxford and IBH Pub. Co. Pvt. Ltd, New Delhi, 2000 p.10.

[5] .Deshmukh, S. N., M. S. Basu, M.S., Reddy, P.S, (1986). Genetic vari-ability, character association and path analysis of quantitative traits in Virginia bunch varieties of ground nut. Indian Journal of Agriculture Science,56: 816–821.

[6] Edwards,L.H.; Ketata, H.; Smith, E.L.(1976). Gene action of heading date,plant height, and other characters in two winter wheat crosses.Crop science16:275-277.

[7] Hamdi, A. (1992). Heritability and combining ability of root characters in lentil (Lens culinarisMedik) Egyptian J. Agric. Res. 199270(1): 247–255.

[8] Idahosa, D. O., Alika J. E., Omoregie, A.U., (2010).Genetic Variability, Heritability and Expected Genetic Advance as Indices for Yield and Yield Components Selection in Cowpea (*Vigna unguiculata* (L.) Walp. Academia Arena 2010:2(5)

[9] Johnson, H.W., Robinson, H.F., Comstock, R. E, (1955). Estimation of genetic and environmental variability in soybeans. Agronomy J. 1955 47: 314–318

[10] Kling, J.G., H.T. Heuberger, H.T., Oikeh, S.O., Akintoye, H.A.,. Horst W,J, (1996). Potential for developing nitrogen-use efficient maize for low input agricultural systems in the moist savanna of Africa. Pages 490-501 in:Proceedings of a Sympossium on Developing Drought and Low nitrogen Tolerant maize, CIMMYT, Mexico.

[11] Pollmer, W.G., Eberhard, D., Klein, Dhillon B.S, (1979). Genetic control of nitrogen uptake and translocation in maize. Crop Sci. 19: 82-86.

[12] Rai, M., S.A. Kerkhi S.A., Singh, A, (2000). Selection parameters for components of grain yield, seed, oil and fibre in linseed (Linum usitatissimum L.). National Seminar on oilseeds and oils research and development needs in the millennium. Feb. 2-4-2000. DOR. Hyderabad, India.

[13] RamaKant., P., Singh, S.K., Sharma, R.M., (2005). Study of heritability and genetic advance for yield components and oil content in diallel cross of linseed (Linum usitatissimum L.). Agricult. Sci. Digest. 25 (4): 290-292.

[14] Reddy, D., Reddaiah, K., Sunil, N (2013). Studies on genetic variability, heritability and genetic advance for yield and quality traits in Tomato (Solanum lycopersicum L.). Int.J.Curr.Microbiol.App.Sci.,2(9): 238-244.

[15] Smalley M D., Daub J L, Hallauer A. R., (2004). Estimation of heritability in maize by parent-offspring regression. Maydica 49: 221-229.

[16] Swamy, R., Ramamurty, T.A., Patil, S.J., R.S. Aradhya, R.S, (1971). Genetic variability and heterosis in maize. Madras Agric. J., 58: 620–3 (R *(11) Heritability and genetic advance estimates for maize genotypes in Shishi Lusht a valley of Karakurm*. Available from:

[17] Syukur, M., S., Yunianti, R, (2012). Teknik Pemu-liaan Tanaman. Penebar Swadaya. Jakarta

[18] Tewari..(1999). Genetic analysis of yield and quality parameters in linseed. (Linum usitatissimum L.) Ph.D. Thesis submitted to S.S.J.M.U., Kanpur.13.

[19] Zaidi A., Khan MS., Amil, M., (2003) Interactive effect of rhizotrophic microorganisms on yield and nutrient uptake of chickpea (Cicer arietinum L.). Eur J Agron 19:15–21