بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Agricultural Studies

Study of Genetic Variability in Ten Forage Maize (Zea mays L.) Genotypes for some Growth and Yield Characters

دراسة التباين الوراثي في الأنماط الوراثية لعشرة ذرة من الأعلاف (Zea mays L.)
لبعض خصائص النمو والعائد

BY:

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الايــة:

قال تعالى:

(ومن اياته انك تري الارض خاشعة فاذا انزلنا عليها الماء اهتزت وربت ان الذي احياها لمحي الموتى انه على كل شيء قدير)

صدق الله العظيم

سورة فصلت الاية (39).

DEDICATION

To my dear mother and father who keep burning their fingers to shine my way, to my brothers and to my sisters. Also to all my friends and those who helps me.

Especially to my Dr: ATIF ELSADIG IDRIS, I dedicate this work.

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*First of all, I would like to render my thanks and praise to Almighty **ALLAH,** who offered me the health and strength to accomplish this work.*

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ABSTRACT

Ten forage maize genotypes were evaluated at winter season Shambat, College of Agricultural Studies, Sudan University of Science and Technology in fulfillment in the period from November 2017 to Feb. 2018. The experiment design was a randomized complete block design with three replications. Six growth and yield characters were measured, genotypic and phenotypic variances, heritability, genotypic and phenotypic coefficient of variation were determined. The results showed that there is significant differences for stem diameter and number of leaves and non significant differences for plant height, fresh weight, dry weight and leaf area. High estimates of heritability (h^2) was obtained for leaf area and lowest estimates of (h^2) was obtained number of leaves. The genotype (3) recorded the highest dry Weight of 3.92 (kg/F) among the studied genotypes.

الخلاصة:

عشرة طرز وراثية من الذرة الشامية العلفية تم تقييمها في الموسم السنوي في شمبات، كلية الدراسات الزراعية، جامعة السودان للعلوم والتكنولوجيا في الفترة من نوفمبر 2017 الى فبراير 2018 صممت التجربة بتصميم القطاعات العشوائية الكاملة بثلاث مكررات اظهرت النتائج وجود فروقات معنوية في عدد الاوراق والوزن الجاف. واظهرت عدم وجود فروقات معنوية في مساحة الورقة، طول النبات، الوزن الرطب وسمك الساق. اعلى قيمة لدرجة التوريث كانت 398.29 لصفة مساحة الورقة. واقل قيمة لدرجة التوريث كانت 6 لصفة عدد الاوراق. الطرز الوراثية (3) اظهرت اعلى قيمة للوزن الجاف وكانت 3.92كجم/فدان .

CHAPTER ONE

INTRODECTION:

Maize or corn (*Zea mays* L). Belongs to family Gramineae (Poaceae) and was originated in Mexico where its oldest known areas were found, about 700 years ago (Mangelsdorf et al, 1974). The crop is grown todays as commercial grain crop between latitude 55° N and 40° S from sea level to 3800 multitude during the last 20 years. Maize has also been grown as commercial crop at higher latitude in North America and in Europe (Pollmer and Phipps, 1980).

In world production, maize ranks the third major cereal crop Following wheat and rice, it is grown in many countries compared to other cereal crops. The crop has a wide range of uses, these include the following. The grains are used, directly as human food and-2 indirectly processed food. Production of starch and as forage to feed the farm animal-3. In the Sudan maize contributes considerably in total grain production since livestock population. The total area cultivated with maize in the Sudan one is hundred forty thousand hectares, this producing six hundred thousand metric tons (FAO, 2000).

Maize was grown as rain fed crop mainly in Nubba Mountains, South Blue Nile and South Darfur. it is also produced in the irrigated areas as a winter crop and flood crop in the northern and River Nile states. Maize has been grown by irrigation around Khartoum state.

Few studies were conducted to study variability in forage maize in the Sudan, in addition, few forage maize were released in Sudan (Ahmad and ELhag, 1999). The main objective of this study is:

(1) To study genotypic, variability in ten forage maize genotypes for some growth and yield characters.
(2) To measure genotypic and phenotypic variances, heritability, genotypic and phenotypic coefficient of variation for different characters.
(3) To study the most productive forage maize genotype among the studied ones.

CHAPTER TWO

LITERATURE REVIEW

2.1 Botanical Descriptions:

Corn as major of the grass family gramineae has many characteristics common to other grassers .It has conspicuous nodes in the stem, a single leaf at each node the leaves in tow opposite ranks, each leaf consisting of sheath surrounding the stem and an expanded blade joint (Fisher,1987).

2.1.1 ROOTS:

The root system of corn as of other grasses consists of two sets of roots, seminal roots whose initials are present in the embryo and adventitious roots which arise from stem tissue after germination; these are often called temporary and permanent, respectively.

2.1.2 STEM:

The stem or stalk of corn plants consists of approximately 24 alternating notes and internodes. The number may very short and underground farming and inverted cone shaped based end of the stem know as the crown under favorable growing conditions .the above around internodes are distributed over stem length of 100 in cages one more with its greatest diameter of about in chess near the ground level the stem gradually lepers to wand its top (Fisher, 1987).

2.1.3 LEAF:

Each leaf consists of thin flat expanded blade with definite midrib and smaller veins and thicker. More rigid sheath surround the enter node above the node to which it is attacker or the inns near surface of the leaf were the blade and sheath joint is a small collar the ligules which extend up ward surrounding the stem (Fisher,1987).

2.1.4 INFIORESCANCE:

Corn is normally a monocots plant with it is functional staminate flowers borne in the ears which terminate all but the basal branches or tiller in the staminate panicles paired spikelet occur with tow flowers per spikelet each floret contains three pistils (Fisher, 1987) the year at a thesis just prior to shedding of former size and the lemma and pale apart.

Making it possible for the anthers to be extruded by the elongating film ants soon afterward the anther break open near the tip forming doers through which the pollen escapes in each land the tassel usually sheds some of its ears. Emerge from the husks but the tassel normally continues to shed from several days after.The silks are ready to be pollinated tassel may shed pollen for week or more pollen grains are produced in nor mouse number’s.

2.2 Maize in the Sudan:

In the sudan maize is normally grown as a rain fed crop in Kordofan Darfur and Southern States or in small irrigated area in Northern states (Ahmed and Elhag, 1999). Recently, there has been and increased interest in maize production in the Sudan (Nour et al., 1997). The most important rain fed production areas are southern Gedarif and Blue Nile the total cultivated area is about 400 thousand feddan annually (FAO, 2016). The increasing of food demands due to grown population in developing countries including sudan is a real challenge that requires extensive research work to increase food production. Hence, different genotypes of maize were released by the National maize research program of the agricultural research Corporation to be grown in the various environments. In order to increase yield of maize different genotypes and landraces have potential of high production and resistance to pests and diseases must be tested to be recommended for mass production (Barcaccia, 2009).

One of the main problems faced by maize in the Sudan there are no plan, policies and clear of producers, lack of staff guidance of trained and working in the field, not to identify areas and production requirements, the, lack of price polices and a clear stimulate product, migration of agricultural workers from rural to urban areas, weakness of the basic data within projects irrigated and rain –fed.

The uses of maize crop in the Sudan in the manufacture of starch and flower after mixing with wheat where it made crumb and porridge, bread and biscuits, but the common use of maize is eaten roasted or boiled, and this use is common in the Nubba Mountains (Barcaccia, 2009).

2.4. Uses of maize:

Maize is used for three main purposes animal feed, food and in industry. Animal feed represents 65% of the total world maize production, while 15%is used for food and the remainder 20% has different industrial uses. The trend for global cereal demand in the next decode is expected to increase, and in the case of maize it is expected to surpass. The demand of what and rice, considering FAO,S latest 5estimation and (CIMMYT) predictions that " the shift (to maize) will be reflected in a 50% increase in the demand form 1995 (558 million tons) to (837 million tons) by 2020 (CIMMYT 1999).

2.5 Forage of maize:

Maize (*Zea mays L.*) green forage, particularly when it contains the stalk, leaves and ears, is an energy-rich feed for ruminant livestock. While maize forage is usually ensiled in cooler regions, year-round maize production in the tropics may allow the continues harvesting of green forage, making ensiling unnecessary (Brewbaker, 2003). Grazing whole maize plants also provides green fodder to livestock in periods of scarcity (dry and hot summers, and winters) (potter, 2012; Newport, 2006). In arear where conditions are harsh and forage is a valuable source of fodder for smallholder owned stock (see forage management below) (Methu et al, 2006). Maize is a high energy feed, better than most other tropical forage crops, of which the DM is often below 40% digestible. In the tropics, while grass forages must be harvested almost monthly, maize forage matures within three months, is harvested only once, and does not require much labour and high machinery costs (Brewbaker, 2003).

2.6. Genotypic variability in maize:

The study of genetic variability is that of population genetics. It is the amount by which individuals in a population differ from one another due to their genes, rather than their environment. Variability is different from variation in that it is the potential to vary rather than the actual variation, (Pollmer and Phipps, 1980). The variation Genetic variability in a population is very important becausewithout variability; it becomes difficult for a population to adapt to environmental change creating a static population (Panda, 2009).

2.6 Variability among crops of corn:

Corn or maize may be classified in seven principle types of crops reported.

2.6.1 Dent corn (*Zea mays* indented)

Is characterized by the presence of hard, horny endosperm at the sides and back of the kernels, with only the starchy endosperm extending to the crown. Depression or [dent] forms at the crown of the kernel as the starchy endosperm dries rapidly and shrinks.

2.6.2 Flint corn (*Zea mays* indurate)

Is charachtraized by having the starchy endosperm enclosed in a relatively thick layer of horny endosperm with a relatively small amount of starchy endosperm are. The kernels are in cline to be rather large and broad and the ears long and slender comparatively small number of rows of kernels.

2.6.3 Sweet corn (*Zea mays* saccharata)

In characterized by translucent horny appearance when important and more or less crinkled or shrivled appearance of the endosperm when dry it is ally high in sngar.

2.6.4 Flour corn (*Zea mays* amylacea)

Is characterized by having little or on dent this also is known as soft corn the grains can easilu be ground in to meal.

2.6.5 Pop corn (Z*ea mays* everla)

Is characterized by an excessive proportion of horny endosperm and the small size of the kernels and ears Rice pop corn has pointed kernels and pearl type has founded kernels.

2.6.6 Waxy corn (*Zea mays* crtina)

Is type of dent corn it contains almost all branched amyl pectin starch, while common corn starch is a mixture of amylase and amyl pectin the endosperm is unusual in that it is possible to substitute it for tapioca this was done on a commercial scale for making adhesives during world wall.

2.6.7 Pop corn *(Zea mays* everta)

Has each kernel enclosed in a pod or hunsk, with the ear it self also enclosed in husks? Pop corn is not grown commercially, but is of inter in studies of the origin of corn. (Panda, 2009).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experiment site:

A field experiment was conducted in the winter season of 2017 in the period from November 2017 to February 2018 at College of Agricultural Studies, Sudan University of Science and Technology, in Shambat Farm. Shambat is Located 23^{o} 35, longitude 15^{o} 31, and altitude 288m sea leaves, within the semi-desert region (Adam, 2002) the soil of the site is described by (Abdeihafiz, 2001) as loam clay it is characterized by a deep cracking, moderately alkaline clays, and low permeability, low nitrogen content and PH (7.5-8) content (50-60%) and high exchangeable sodium percentage (ESP), in subsoil.

3.2 Experimental material and Design:

The genetic material used in this study consisted of forty (40) advances genetic maize lines with one local check as presented in table 1.These seeds of forage maize genotypes to be used in this study obtained from Faculty of Agriculture University of Khartoum. The experiment was carried out in Randomized Complete Block Design (RCBD) with three replicates, planting was done manually in plots consisted of 4 rows and, 6 meters long which spaced 0.70m between rows and 15cm between holes.

3.3 Cultural practices:

Sowing date was the third week of November (29.11.2017) after land preparation was done as the following: deep plowed first using disc plough, harrowing by disc harrow, leveling and ridging. Three seeds per hill were sown. The irrigation each ten days. A dose of chemical fertilizer urea, 1N (30kg /ha) were applied after two weeks from sowing. Hand weeding was done to keep the plot free of weeds.

3.4 Data collection:

Sample of ten randomly selected plants from each plot throughout experiment was used to record data from reproductive traits as following:

— 3.4.1 Plant height (cm)

— Measured in centimeter as an average height of the random sample of ten plants in the harvest area. It was measured from the soil surface to the node bearing the upper most ears.

3.4.2 Stem diameter (cm)

Stem diameter was measured by using venire. Measurements were taken on deferent positions on the stem and the average from sample of ten plants in the harvested area.

3.4.3 Leaf Number per plant:

It was determined from harvested area as ten plants taken randomly from each plot and then number of leaf per plant, as average was determined.

3.4.4 Fresh Weight per plants (kg/ha)

The average weight was taken at random from the bulk of plant from a random samples of ears harvested in each plot by (Kg).

3.4.5 Dry Weight per plants (kg/ha)

Taken of ten plants from each plot then was the dried via direct sun light and weight to determined its dry weight. The forage yield was obtained by converted the yield of the actual harvested to kg/h.

3.4.6 Leaf Area (cm)

I was measured an average three leaf per plant from each plot.

3.5 Statistical analysis:

Analysis of the variance was carried out on data collected used statistical analysis system in accordance to analysis of variance (ANOVA), and means were separated for significant by LSD Test at 5 % level using statistic 8 computer programs.

Table (3-1): Zea Mays' genotypes used in the experiment:

N0	Genotype	No	Genotype
1	H10	1	Mk6
2	H11	2	MK8
3	H12	3	MK13
4	H13	4	MK16
5	H14	5	Mk20

Table (3-2) the form of analysis (ANOVA)

Source of variation	d.f	MS	EMS
Replication	(r-1)=2	M3	
Genotypic	2(g-1)=9	M2	$\sigma 2g+\sigma 2e$
Error	(r-1)(g-1)=18	M1	$\sigma 2e$
Total	(rg-1)=29		

Where;

r=replication

g=genotypes

MS=meants square

EMS=Expected mean square

M1.M2 and M3 mean sq6for error, genotypes and replication respectively.

$\sigma 2g$=genotypic variance variance

$\sigma 2e$= error variance

3-6 Genetic parameters estimate:

The genotypic (σ2g) and phenotypic (σ2ph) variances were obtained from the analysis of variance total according to Comstock and Robison (1952).

_Genotypic variance (σ2g) = M_2-M_1/r

_phenotypic variance (σ2ph) = σ2g+σ2ph

Where;

r= replication

M_1=mean square for genotype

M_2=mean square for error

3-7 Heritability (h^2):

Heritability (h^2) broad sense was estimated according to Falconer (1989).

Heritability (h^2) =σ2g/σ2ph*100

Where;

σ2g= genotypic variance.

σ2ph= phenotypic variance

CHAPTER FOUR

RESULTS

4-1 Phenotypic variability:

The analysis of variance revealed there were significant difference between forage maize genotype for stem diameter and number of leaf and no differences for plant height, leaf area, fresh weight and dry weight genotypes .

4-1-1-Plant Height (cm):

The result of plant height showed that the highest plant height (151.3) was obtained by genotype (7) and the lowest (101.5) was obtained by the genotype (3). The grand mean for plant height was (124.8) and the C.V was (33.7).

4-1-2 Number of Leaves:

The result of number of leaves showed that the highest number of leaves (11.8) was obtained by genotype (2) and the lowest (9.76) was obtained by the genotype (10). The grand mean for number of leaves was (10.9) and the C.V was (9.4).

4-1-3 Leaf area:

The result of leaf area showed that the highest leaf area (356.9) was obtained by genotype (7) and the lowest (250.7) was obtained by the genotype (1). The grand mean for leaf area was (281.0) and the C.V was (26.8).

4-1-4 Stem diameter (cm):

The result of stem diameter showed that the highest stem diameter (2.03) was obtained by genotype (6) and the lowest (1.28) was obtained by the genotype (3). The grand mean for stem diameter was (1.61) and the C.V was (24.7).

4-1-5 Fresh weight:

The result of fresh weight showed that the highest fresh weight (8.80) was obtained by genotype (7) and the lowest (5.11) was obtained by the genotype (2). The grand mean for fresh weight was (6.85) and the C.V was (32.4).

4-1-6 Dry weight:

The result of dry weight showed that the highest dry weight (3.92) was obtained by genotype (3) and the lowest (1.54) was obtained by the genotype (1). The grand mean for dry weight was (2.38) and the C.V was (62.5).

Table (4.1) means squares of general yield characters in forage maize:

Source of variation	**Replication**	**Genotype variance**	**Error variance**	**F**
D.F	2	9	18	
Plant high(cm)	6004.2^{NS}	811.88^{NS}	1779.05^{NS}	0.4
Dry weight	10.91^{NS}	1.42^{NS}	2.61^{NS}	0.5
Fresh weight	17.55^{NS}	2.70^{NS}	4.95^{NS}	0.5
Leaf area(cm)	113657.2^{NS}	3112.0^{NS}	5699.4^{NS}	0.5
Number of leaves	5.73*	1.23*	1.07*	1.2
Stem diameter(cm)	0.00*	0.13*	0.16*	0.8

Table (4.2) means of different characters in 10 genotypes of forage maize evaluated at shambat farm in winter season November 2017.

No.	Genotypes	Ph(cm)	SD(cm)	No. of L.(cm)	L.area	FW	D.W
1	H10	^{A}107.1	^{BA}1.5	^{BA}11.4	^{A}250.7	^{A}6.66	^{A}1.54
2	H11	^{A}122.0	^{BA}1.5	^{A}11.8	^{A}272.3	^{A}5.11	^{A}2.49
3	H12	^{A}101.5	^{B}1.2	^{BA}10.1	^{A}253.6	^{A}7.43	^{A}3.92
4	H13	^{A}139.0	^{BA}1.7	^{BA}10.6	^{A}268.6	^{A}6.90	^{A}2.49
5	H14	^{A}125.5	^{BA}1.6	^{BA}10.4	^{A}283.2	^{A}6.66	^{A}2.13
6	MK6	^{A}135.8	^{A}2.0	^{BA}11.0	^{A}311.7	^{A}7.49	^{A}2.49
7	MK8	^{A}151.3	^{BA}1.8	^{BA}11.4	^{A}356.9	^{A}8.80	^{A}3.44
8	MK13	^{A}130.6	^{BA}1.6	^{BA}11.2	^{A}271.8	^{A}6.66	^{A}2.73
9	MK16	^{A}132.4	^{BA}1.5	^{BA}11.0	^{A}255.7	^{A}6.54	^{A}2.61
10	MK20	^{A}103.5	^{B}1.4	^{B}9.76	^{A}285.2	^{A}6.30	1.96^{A}
Mean		124.9	1.6	10.9	281.0	6.85	2.58
C.V		33.7	24.7	9.47	26.86	32.4	62.57
L.SD		72.3	0.6	1.77	129.5	3.82	2.77

Means with the same letters are not significantly different at (0.05).

Table (4.3) Phenotypic, Genotypic and Heritability for different characters for 10 genotype of maize forage:

characters	Genotypic variances	Phenotypic variances	Heritability (h^2)
Dry weight	0.39	1.81	21
Fresh weight	0.75	3.45	21
Laef area(cm)	862.4	3974.4	21
Number of leaves	0.08	1.39	0.05
Stem diameter(cm)	0.01	0.14	0.92
Plant height(cm)	322.3	1134.2	0.71

4-2 Phenotypic, Genotypic and Heritability coefficient of variation and genetic:

Estimates of genotypic, phenotypic and heritability of variation for most characters were including plant high, stem diameter, number of leaves, leaf area, dry Wight and fresh wight, high estimates of (Genotypic) was recorded for leaf area (862.4). Low estimates of (Genotypic) was recorded for stem diameter (0.01).

High estimates of (Phenotypic) was recorded for leaf area (3974.4) and low (Phenotypic) was recorded stem diameter (0.14).

High estimates of (Heritability) was recorded for stem diameter (0.92) and low (Heritability) was recorded for number of leaves (0.05).

CHAPTER FIVE

DISCUSSION

In this study, the number of leaves and leaf area showed significant difference between the ten forages maize genotypes. This variability could be attributed genetic factors, environmental factors or to the interaction them. This variability could be of a great value in any forage maize breeding program. Variability in forage maize was studied by many authers. e.g. Ahmad and ELhag (1999); Brewbaker (2003) and Nour, et al (1997).

The genotypes (H12, MK17) showed highest value of plant height in addition, the genotypes (H11, MK13) showed highest value of number of leaves, the genotypes (H12, MK6) showed highest value of stem diameter and the genotypes (H10, MK9) showed highest value of leaf area. Therefore, these genotypes (H12, MK17, H11, MK13, H12, MK6, H10 and MK9) could be used by farmers of forage maize or in any forage maize breeding program.

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CHAPTER SIX

CONCLUSIONS

Based on the results obtained from this study, it could be concluded as the following:

1- Variability existed for some traits in the ten forage genotypes could be of a great value in any forage maize breeding program.

2- The genotype (2) attained the highest value of dry weight, therefore, it could be used by farmers of forage maize.

3- The genotypes (H12, MK17, H11, MK13, H12, MK6, H10 and MK9) could be also used by farmers of forage maize or in any forage maize breeding program, due to their heights and leaves.

REFERENCES

Abdelhaffiz., M. E (2001). Effect of Partially Acidulated Phosphate Rocks and Tripje Supewrphosphate and Their Combination on Growth Mineral Co-position and Yield of Wheat PhD thesis, sudan University of Science and Technology.

Adam, H.S. (2002). The Agricultural Climate Second Edition Gezira University press Wad- Madani, Sudan. In ARABIC.pp 119

Ahmad and F.E ELhag H.**A** (1999). Effect of watering interval on yield and yield component of tow maize(Zea mays L) Cultivars grown in summer and winter. U. of K. J. Agric sci, 7 (1): 20-32.

Baricaccia,G. (2009). Moleculer markers for characterizing and conserning crop plant germplasm. P. 23-25. In: Mohamd, J.S; Bara; D.S, eds. Molecular terchiques in crop improvement . 2ed.

Brewbaker, J. L. (2003). Corm production in the tropics: the Hawaii experience. Uni.V.Hawaii, Coll. Tropic . Agric. Hum Resources.

CIMMYT, (1999). Maize production Technology for the future: challenges and opportunities: procecdings of the sixth eastern and Southern Africa Rrgional Maize Confer-ence, 21-25 September 1998. Addis Ababa Ethiopia.

FAO, (2000). Production year book, vol-2. FAO, Rome.

FAO, (2016). FAO statistcal Data base, http://www. Fao. Org/.

Fisher, K.S and Polymer. A.F.E (1987) in physiology of tropical field crops, john Wiley and sons.

Gomez.K.A and Gomez, A.A (1987). Statistical procedures for agricultural research, 4 Ed. John Wiley and sons. New York.

Kramer, p.j. (1980) drought stress and origin adaptation. In N.C Turner and J 70Kramer (EDS) adaptation of plants to water stress and high temperature stress. Wiley. Inter. Science, New York. P.7.20.

Mangelsdorf p.c. (1974) corn: its origin, evaluation and improvment Harvard Univ-press Ccambridge, MA.

Methu, J.N; Kiruiro, E.M; Abate, A.N. , 2006. Your feed shortage problems. Use maize forage. KARI resource center, Nairobi.

Web (http: //www kalro. Org/ fileadmin/ publications/brochures/maize.

Newport, A, 2006. Grain on the stump. Beef, Beef Magazine, Oct 2006.

Web (http:// beef magazin. com/ mag/ beef-grain-stump.d Appied Biotechnology 11:6469.

Nour, A. M.; Nur Eldin, I and Dafalla M (1997). Crop development and improvement Annual report of maize research program medaini sudan of sweet corn common corn and teosinte Grop Breeding an

Panda, S.C. Bhagabat Panda (2009). Maize crop science PAN 633-15. Agrobios (INDIA). Emeritus scientist, ICAR, Former Dean, College of Agriculture.

Pollmer . W.G and Phipps R.H (eds), (1980). Improvement of quality Traits of Maize for Grainand Silave use 493-500.

Potter, B 2012 Grazing corn in the Northwest. OMAFRA Virtual Beef, Weest Beef Dev. Center, factsheet 2012. 30.

Web (http: //www. forage beef. ca/app 33/forage beef /index-body. jsp