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Sudan University of Science and Technology

College of Graduate Studies

Evaluation of Growth , Yield and Yield Components of Six maize Genotypes in Khartoum state

تقييم النمووالأنتاج وعناصر الإنتاجيه لسته أصناف من الذره الشاميه بولأيه الخرطوم .

A thesis Submitted in Partial Fulfillment for the Requirements for the Degree of M.Sc. (Agronomy).

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الآية

قال تعالى:

(أَمَّنْ خَلَقَ السَّمَوَتِ وَالأَرْضَ وَأَنْزَلَ لَكُمْ مِّنَ السَّمَآءِ مَآءً فَأَنْبَتْنَا بِهِ حَدَآئِقَ ذَاتَ بَهْجَة مَّا كَانَ لَكُمْ أَنْ تُنْبِتُوا شَجَرَهَآ أَءِلَهٌ مَّعَ اللهِ بَلْ هُمْ قَوْمٌ يَعْدِلُونَ)

صدق الله العظيم

سورة النمل الآية (60)

DEDICATION

Thesis study dedicated

To my great father, my lovely mother,

My wife & kids

My brothers & sisters,

My friends & colleagues.

And whom without their great assistance I could have not to accomplish this achievement.

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First of all, I would like to thanks and praise Almighty Allah, who offered me the health and strength to accomplish this work. •

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SHOMEEN.

CONTENTS

LIST OF APPENDECES

ABSTRACT

A field experiment was carried out at the demonstration farm of College of Agricultural Studies, Sudan University of Science and Technology during the winter season (2014-2015).

The experiment was aimed to evaluate six genotypes of maize (Zea mays L.) for growth , yield and yield components. The experiment a randomized complete block design (RCBD) with three replicates was layed out.

The treatments were: Var 113, Mugtama 45, Sweet corn, Golden corn, Hudiba 1 and Hudiba 2.The growth parameters studied included: Plant height, Number of leaves, Stem diameter and Leaf area. Yield components were: Grains weight /cob, 100 grain weight, Number of grains /cob, Number of rows/cob, Number of grains/line and yield t/ha.

All genotypes obtained showed significant difference in plant height in both 30 and 45 days. Also Var 113 and Hudiba 2 have significance difference in number of leaves per plant over all other genotypes. Var 113, Hudiba 2 and Sweet corn gave significan difference in leaf area in 30, 45 and 60 days. There are no significan difference in Stem diameter, Grains weight /cob, Number of grains /cob and Number of rows cob, but there was significant difference in both Number of grains/line and yield(t/ha).

الخلاصة

أجريت تجربة حقلية لموسم واحد بالحقل التجريبي في كلية الدراسات الزراعية بجامعة السودان للعلوم و التكنولوجيا في شتاء 2014-2015 لتقييم ستة اصناف من الذرة الشامية على النمو ، الانتاج وعناصر الانتاجية بولايه الخرطوم. تم استخدام تصميم القطاعات الكاملة العشوائية بثلاثة مكررات و كانت المعاملات كالاتي:الصنف113، مجتمع45 ، الذرة السكرية، الذرة الذهبية، حديبة1و حديبة2. و كانت القراءات نمو الخضري كالاتي: طول النبات عدد الاوراق، سمك الساق، مساحة الورقة الانتاجية : وزن البذور لكوزه ، وزن المائة حبة، عدد البذور للكوزه، عدد الصفوف بالكوزه، عدد البذور بالصف الواحد و الانتاجية بالطن في الهكتار.

أظهرت التنتائج وجود فروقات معنوية في طول النبات في كل من 30و45 يوم. و ايضا تفوق الصنف113 و حديبة2 على باقي الاصناف بفروقات معنوية في عدد الاوراق للنبات. كذلك الاصناف 113 ،حديبة2 و الذرة السكرية أعطت فروقات معنوية في مساحة الورقة على باقي المعاملات في(30,45,60 يوم.) بينما لا توجد فروقات معنوية في كل من سمك الساق ، وزن البذور(الجرام)للنبات الواحد، وزن المائة حبة (بالجرام) ، عدد البذور للنبات و عدد الصفوف.الا أنه هنالك فروقات معنوية في كل من عدد البذور في الصف و الانتاجية بالطن للهكتار.

CHAPTER ONE

INTRODUCTION

Maize (corn) Zea mays L. is an annual herbaceous monocots plant belongs to the family poaceae. It is an important grain crop of the world and rank third most cereal crop after wheat and rice, with average yield around 4.1t/ha, due to high productivity, maize is called Queen of cereals and grown primary for grain, secondarily for fodder, row material industrial process and diversified products. Maize is rich in starch (carbohydrates) with an average of about 70%, but low in protein (about 9.5%). The oil is concentrated mainly in the germ with an average of 4% of the kernel weight. The composition of the other components of the kernel are 1.4% sugar, 2.3% crude fiber and 1.4% ash.Its believed to originate in Mexico. Maize is characterized by very wide genetic diversity. The species maize is known to have about seven sub-species. The crop; accordingly, is regarded as a multipurpose crop (Sys et. al 1993).

Sudan is one of the richest countries with animal wealth. Thus Animal production represents one of the major economic sectors of the country .It is natural that forage production should receive much attention, especially in area of the country which is densely populated as Khartoum State. This is to meet the ever increasing demand for animal products (Khair, 1999).

In Khartoum state; according to the State Ministry of Agriculture, irrigated forage crops occupy about 52% of the total cultivated area, and however, there is a production gap estimated by 37%,this gap hinders the export rates of life sheep and castles and forage mainly to Gulf States. That large numbers of animals transported from western Sudan through Khartoum to exports, stay for fattening period. Such fattening the demand for forage, which is originally high. The increase production gap was attributed mainly to the traditional cultural practices by the produces. Forage crops produced is mainly sorghum cultivars likeAbu70.Varing forage crop is recommended to fill this gap, especially in winter where the yield of sorghum cultivars is very low .Forage maize is regarded; as promising substitute as a winter forage crops (Dawelbeit,2007).

Despite an increased area of land has been dedicated to cultivate maize since the mid 2000s, production per hectare is still low. However, the yield of maize in recent years has increased significantly due several breeding programs as response to pest and diseases such as the American rust. Improved high yielding maize variety can express its full genetic potential only when offered optimum management resources. Hybridization is one of the many improvement methods for maize, hybrids usually have higher yields and they are more resistant to weeds, other pest and diseases and they have early maturing dates. The full expression of these characteristics might vary with environments in order to adopt crop variety; its growth as well as the yield potential in the target environment should be evaluated (Rabih,2007). Hence the objective of this work was to determine the growth and yield parameters in four open line pollinated varieties using the best of two hybrid line varieties as the control in Shambat area central of Sudan.

CHAPTER TWO

LITERATURE REVIEW

2.1. General:

The primary center of origin of maize is considered by most authorities to be Central Africa and Mexico, where many diverse types of maize are around. The discovery of fossil maize pollen with other archaeological evidence in Mexico indicates that maize was a significant crop in Mexico 5,000 year ago and perhaps earlier. American Indians grew land selectivity improved maize from 3400 B.C. to 1500 A.D. today maize known in every suitable agriculture region of the globe. Among the cereals productivity of the maize is the highest (4.1t/ha) as compared to rice (3.7t/ha) and wheat (2.5t/ha) corn is produced largely in the western hemisphere and Europe. It is the most important grain crop in the united states. About 40 % of the world maize production of the United States followed by china. About 58% of the world maize production is in the developed countries with the U.S.A. as the major producer and exporter while about 22% developing countries. Other corn producing countries are China, Brazil, Mexico, Russia, Indian and Philippines Sys et al (1993).

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2.2. Botany:

Maize is known as corn in a member of grass family Poaceae. It is believed to be originated in South America, most probably in Mexico, Guatemala, or Honduras (Mangelsdorf,1947),itis classified in to seven sub-species according to the grain structure (Sharma, 1972 and Rabih, 2007):

1. Flint corn: indurate, with hard, horny -rounded or short flat kernels used for food and feed purposes.
2. Dent corn: indentata, the kernel contains soft and hard starch, and becomes indented at maturity .It is a major crop used to make food, animal feed and industrial products.

3. Sweet corn or green corn: saccharata .It is often eaten fresh, which contain high percentage of sugar in the milk stage, used in livestock feeds and other industrial purposes as in the case of glucose and starch production.
4. Waxy corn: certain the grain have waxy appearance when cut, it's a source of starch.
5. Pop corn: everta: with small ears and small pointed rounded kernel. It has got very hard endosperm when exposed to dry heat, are popped or averted by expulsion of the contain moisture and form a white starchy mass many times the size of the original kernel.
6. Flour corn also known as soft or squaw corn :amylacea it has kernels shaped like those of flint corn or composed almost entirelyof soft starch.
7. Indian or Pob corn:. its grown by Indians, it has white red brown or multicolor kernels, used in mixture with wheat flour to make bread, this corn can make a greatest quantity of epigeous mass than other plant, so it can be used for fodder.

2.3. Economic Importance:

Maize ranks number three among the important cereals in the world following wheat and rice (Nour et al, 2005).It is a multipurpose crop with avariety of food and feed uses. It has also various Industrial uses, because of its wide genetic variability and broad global distribution (Aoad et al 2006, and Rabih et al, (2007).In Sudan the maize immature cobs are eaten after boiling or roasting .The green matter is used as fodder especially in winter (Zahir et al, 2007).

In Khartoum State, the livestock size is estimated to be around 800000 units according to the statistics of the State Ministry of Agriculture in 2010.And the production of irrigated fodders represents 84.5% of the total State production, however, the gap between the production and the consumption is estimated by 39.1%.This gap was attributed mainly to 500000 animal units come across the State to the export ports, and stay for fattening period in the state. The maize is one of several alternatives to fill the gap especially in winter to face the season low productivity of other grass fodder (Zahir et al, 2007).

2.4. Ecology:

2.4.1. Climate:

The maize can grow within a temperature range of 14-40c, with optimum temperatures of 18-21c.The same authors added that the crop germination is reduced by 13c, and fails at10c. They showed that maize grow in regions that receive 500-5000mm\annum**.**

An optimal water supply can be secured in regions that have precipitation of 500-120mm\annum. The crop is sensitive to moisture stress from the beginning of flowering until the end of the grain formationi.e.50-100 days after sowing (Sys et al 1993).

2.4.2. Soil:

Maize can grow on wide range of soils, on conditions that they are deep, well aerated, and well drained. The optimum growth rates are expected on loams and salty loams with adequate organic matter. The PH range is 5.2-8.5, and the optimum PH 5.8-7.8(sys et al, 1993).

2.5. Cultural practices:

2.5.1. Sowing:

The recommended optimum sowing forage maize is during the winter season in Khartoum and River Nile State (Khair, 1999). The same author pointed that for optimum yield, forage maize should be sown on ridges when grown on clay soils .Optimum plant population is 46000-61000 plant per hectare (Rabih, 2007).

2.5. Fertilization:

Most of the soils in the Sudan are regarded as moderate or poor fertile (Dawelbeit et al,_2007) They showed that this is due to the low Content of organic matter <1.0%, low nitrogen <0,1% and low available phosphorous less than 10 ppm. Thus, applying fertilizers containing nitrogen and phosphorous are expected to increase the yield of all irrigated crops. (Nour et al, 2005) reported that the application of nitrogen at the rate of 86kg\ha as urea increased maize yield significantly. While the application of phosphorous as triple super phosphate up to 86kg P_2O_5/ha did not affect the maize yield significantly. Supportive report recommended the application of 86kg N/ha as urea for maize. This recommendation was revealed after (Salih et al, 2007)studies.

2.6. Phenotypic variability

Phenotypic variability in a population is of paramount importance for any successful breeding program me. This is because selection of the desirable genotypes for a certain trait will not be effective unless considerable variation is existaing in the material under study. Evedance for the presence for appeasable amount of phenotypic variation for yield and other quantitative traits in open pollinated cultivars of maize and their interventional crosses was provided by the work of many maize breeders (Lonnquit, 1953; Robinson et al, 1955 and Castro et al., 1968).

Phenotypic variability in maize for the different characters is attributed to genetic as well as environmental factors (Hillier and Miranda, 1981).

Sprague (1966) reported that any effective plant breeding programmed is depending upon the existence of genetic variability. Further mores, the choice of breeding method to be applied in the program depends upon the relative magnitudes of the additive dominance, plasmatic, material components of genetic variance and heritability estimate. Hillier and Miranda (1981) reported that genetic diversity in the lines used in crosses is generally recognized to be important.

Days to sulking, grain yield ear length, kernel rows, and 100 kernel weight and ear height showed wide range of genetic variability. (Sinai ,et al 1970) in a study of two intervarietal crosses of maize, observed large genetic variation for plant height, flowering date, number of leaves, 100 seeds weight and grain yield per plant.Gorgan and(Francis 1972) reported that number of kernel rows had little variation within most crosses, but highly significant variations were observed for grain yield.

(Novado and Cross 1990) from the study of three dialled sets among eight parental synthetic genotypes, reported the existance of significance variations among crosses within one or more diallels for grain yield, ear per plant, kernel weight, number of leaves, leaf length, leaf width and silking date.

(Higgs and Russel 1968) indicated that genetic variation within inbred lines of maize is important for hybrid corn seed producers if this variation affects the performance of the hybrids that they produce.

2.7. Hybrid vigor in maize:

Hybrid vigor or heterosis is known as the increased vigor of the F1 hybrid over the mean of its parents or the better parent (Hays et al, 1955).

Heterocyst have been observed for seed or forage yield in essentially oust crop plants, but the level of heterosis is widely different among the different species. In general, heterosis is greatest in cross pollinated crops and least in self pollinated ones (Feber, 1987). The performance of hybrid relatives to its parent can be expressed by two ways mid-parent heterosis, performance of the hybrid compared to the average performance of its parents, and heigh parent heterosis, performance of the hybrid compared to that of the better parent in the cross (Feber, 1987).

(Johnson 1973) in a study of a number of in bred lines and F1 hybrids indicated that leaf area index was inherited in highly heterotic manner.

The importance of heterosis in grain yield and its components has been indicated by mny workers.(Robinson and Cockerham 1961) showed that heterosis measured form the mid-parent was manifested in the genotypes crosses for yield.

CHAPTER THREE

MATREIALS AND METHODS

3.1. Experimental site:

A filed experiment was carried out on the demonstration farm of the College of Agricultural Studies, Sudan University of Science and Technology at Shambat. Witch located at latitude 15^0- 32^0N and Longitude 32^0- 35^0E, in the semi –desert region. The experiment was sown in the winter season of 2014\2015, on Loamy soil with pH 8.2 as described The farm soil described as alkaline clay soil (Adam, 2002), (Appendex 1).

3.2. Materials

3.2.1. Plant materiel:

. Six genotypes of maize seeds were obtained from Wad Madani Research Station, El- Gazzira State.

3.2.2. Methods:

3.2.3. Treatments:

The experiment treatments were:

1. Var 113.
2. Mugtama 45.
3. Sweat corn.
4. Golden corn.
5. Hudiba 1.
6. Hudiba 2.

3.2.4. Experimental design:

The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replicates to evaluate six genotypes of maize for growth, yield and yield components under Khartoum state.

3.2.5. Cultural practices:

3.2.5.1. Land preparation:

The experiment site was ploughed, harrowed, leveled, and ridged and divided into plots. The plot size was 3.5*3 m^2.inter-row spacing was 70cm, intera-row spacing 20 cm, and two seeds per hole. Each treatment was repeated three times.

3.2.5.2. Sowing:

2-3 Seeds were sown in holes 20 cm intera-row spacing apart on the tops of ridges in November 2nd, 2015. The plots were irrigated immediately after sowing. Most of the plants emerged 4 days after sowing. Thinning the plants to tow plants per hole was carried out 7 days after sowing. Prevailing successive irrigations were given at 10_12 days intervals according to the prevailing weather condition. Other cultural practices were carried out according to recommendation.

3.3. Data collection and analysis:

3.3.1. Data collection:

3.3.1.1. Plant height (cm):

The apparent plant height (cm) was taken from 5 plants randomly selected from the middle of each plot one month after sowing. The mean plant height (cm) was recorded for each treatment.

3.3.1.2. Number of leaves/plant:

5 plants were selected randomly from the middle of the plot. counted and the mean of number of leaves/plant was taken.

3.3.1.3. Leaf area/m^2:

5 plants were selected randomly from the middle of the plot. Their maximum length (cm), and maximum width (cm) were take, the leaf area was calculated flowing stickler (1961) as follows:

Leaf area (cm) = Maximum length (cm) x Maximum width (cm) x 0.75.

The mean leaf area (cm^2) was recorded for each Variety.

3.3.1.4. Stem diameter (cm):

A venire was used to measure the stem diameter (cm) at node number 2 from the stem base, for five randomly selected plants from the middle of each plot .The stem diameter (cm) was recorded for each treatment.

3.3.2.5. Grains weight (gm)/cob:

Five cobs were taken randomly from each cob collected seeds and weighted seperalty and collect weighted seeds and divided to five and to get the grain weight per cob.

3.3.1.6. 100 grain weight/(gm):

100 seeds taken from each cob of five plants in the plot was weighted and registered as100 grain weight.

3.3.1.7. Number of grains/cob:

Three cods from each treatment were taken and number of gains in each cob were counted and the average was taken to determine number of grains in each cob for each treatment.

3.3.1.8. Number of rows/cob:

Five cobs from each treatment were taken and number of rows were counted and the average was registere

3.3.1.9. Number of grains/line

Three lines of grain selected randomly and counted for each line separately and collected and divided to get the number of grain for each line.

3.3.1.10. Grain yields t/ ha:

Seeds from the plants taken from an area 0.5 m^2 were weighted by grams, and then converted to tons/hectares by the following equation:

Grain yield gm= $(1m)^2$x100000\1000=yied.t\h.

3.3.2. Statistical analysis:

The analysis of variance (ANOVA) was carried out on the data collected. The mean of the treatments were separated by Duncan Multiple Range Test (DMRT) according to (little and Hill 1978).MSTAT-C was used.

CHAPTER FOUR

RESULTS

4.1. Growth characters:

4.1.1. Plant height (cm):

There are significant differences among the verities ,genotype Golden corn Produced higher plant height than others in First 30 days after sowing (47.6cm) while Genotype in the second reading var.113 showed the lower plant height, after 45 days (33.47cm) Genotype in the thied reading Magmata 45 is higher and ver113 is lower one, in 60 days the is no significant differences among verities.

Table 4.1.1

Genotype	plant height (day)		
	30	45	60
Var 113	33.47 B	52,20 B	121,93 A
Mugtama 45	46,73 A	76,87 A	146,60 A
Sweat corn	41,93 AB	76,33 A	135,40 A
Golden corn	47.6.A	71.60 A	126.13 A
Hudiba 1	44.07 A	65.47 AB	111.87 A
Hudiba 2	47.27 A	74.80 A	130,93 A
Mean	43.51	68,54	
SE#	3.99	7.39	17.37
L.S.D.	8.90	16.47	38.71

*Means followed by the same letter for each growth stage are not statically different according to DMRT at 5%level.

4.1.2. Leaf number:

From statistical analysis of variance it was clear that all genotypes showed significant differences in number.

The highest number of leaves for the first reading was observed by Var 113 genotypes (6.80), while the lower number of leaves was (5.13) observed by Hudiba 1 and Hudiba 2. In the second reading Hudiba 2 recorded the largest number of leaves (8.73) as compared to others, the lowest number of leaves was obtained by Hudiba 1(6.87).

Table 2. Number of leaves (30\45\60)day

Genotype	Leaf number (day)		
	30	45	60
Var 113	6.80 A	8.53 A	12.13 A
Mugtama 45	5.13B	7.73AB	11.20 B
Sweat corn	5.60 B	7.93 AB	11.67AB
Golden corn	5.87 AB	8.27 AB	11.33 B
Hudiba 1	5.60 B	6.87 B	11.20 B
Hudiba 2	5.13 AB	8.73 A	11.53 A
Mean	5.85	8.81	11.68
SE#	0.49	0.68	0.68
L.S.D.	1.10	1.51	1.51

*Means followed by the same letter for each growth stage are not statically different according to DMRT at 5%level.

4.1.3. Leaf area (cm^2) and stem diameter (mm):

All genotypes are presented that no significant differences in leaf area and stem diameter among all verities.

Table 4.13.

Genotype	Leaf area	Stem diameter
	$(Cm)^2$	$(mm)^2$
Var 113	129.20 A	21.49 A
Mugtama 45	86.60 B	22.28 A
Sweat corn	109.60 A	18.15A
Golden corn	80.07B	17.07A
Hudibat	92.93 B	17.46A
Hudiba 2	114.87 A	18.51A
Mean	102.21	19.16
SE#	38,95	3.74
L.S.D	86.79	8.32

*Means followed by the same letter for each growth stage are not statically different according to DMRT at 5%level.

4.2. Yield and yield components:

4.2.1. Grain weight (gm)/cobs, 100 grain weight (gm)/cob and number grains/cob:

All genotypes produced no significant different.in grains weight/cob,genotype Sweet coren higher and genotype var 113 is lower,in hundred grain weight genotype Hudiba 2 is higher and Golding corn is lower,in numder of grains/cob,genotype Magtama 45 is higher an

Table 4.2.1

Genotype	Grain weight (gm)/cob	100 grain weight(gm)/cob	Number grain/cob
Var 113	17.40 A	10.33 A	237.20 A
Mogtama 45	17.92 A	11.07 A	292.67 A
Golden corn	21.33 A	11.30 A	261 A
Golden corn	19.93 A	10.20 A	226.59 A
Hudibat-1	19.92 A	10.57 A	257.20 A
Hudiba-2	17.97 A	11.50 A	289.32A
Mean	19.08	19.08	260.80
SE#	3.483	1.61	38.05
CV%	7.76	3.58	84.77

*Means followed by the same letter for each growth stage are not statically

different according to DMRT at 5%level.

4.2.2. Number grains/cob, number grains/line and grain yield t/ha:

The tested hybrids are presented significant differences observed in number of grain /line, grain yield t/ha, but there were no significant differences in number of rows/cob.

Table 4.2.2

Genotype	Number of rows/ cob	Number of grains /line	Grain yield t/ha
Var113	12.07 A	16.47 B	10.60 C
Mogtama 45	13.47 A	23.87 A	12.60 AB
Sweet corn	14.01 A	22.13 A	11.72 AB
Golden corn	12.77 A	19.91 AB	10.87 C
Hudiba 1	12.40A	15.40 B	8.29 D
Hudiba 2	13.053A	20.78 AB	13.63 A
MEAN	10.82	19.76	11.28
SE#	1.101	2.44	0.52
C.V%	2,45	5.43	1.15

*Means followed by the same letter for each growth stage are not statically different according to DMRT at 5%level

CHAPTER FIVE

DISSCUSION

5.1. Environmental effect and cultural practices:

The experiment was conducted in winter season at Shambat under irrigation; the environmental condition is semi-desert climate. It was 100-250 mm/annum. in additional, due to irrigation canal damage at Shambat, the crop was subjected to water stress during seed filling period, hence there was a reduction in 100-grin weight and consequently a reduction in cob weight and final grain yield at Shambat. The effect of water stress, during the grain filling period, on kernel weight has been reported by Khalafalla (1993).

5.2. Growth characters:

5.2.1. Plant height:

From the results obtained for the plant height in table (4.1) showed that a significant deference between all varieties in 30 and 45 days and no significant deference after 60 days, it is clear that plant height increase with increasing days. Also cultivars Mugtama-45 and Hudiba-2 gave the highest plant height in 30 and 45 days but in 60 days Golden corn was highest these results were connected to Ramadan (2004) this indicated the existence of a wide range of variability which can be attributed to genetic Khalafalla (1993). Khatar (1986) reported a wide range of genetic variability of the plant height. Thus, can be used in breeding programme for crop improvement of this character especially when forage production is under concederation.

5.2.2. Leaf number/plant:

Al the results showed that there significant deference between all cultivars in (30, 45 and 60 days).Var 113 and Hudiba-2 gave the greatest leaves per plant in table (4.2) reported similar results when intercropped with clitoria and cowpea (Aman, and Ibrahim, 2013). Difference among evaluated maize accessions for this trail was significant this due to the fact that the environmental for this trail was greater than genotype one. Thus expression of this character can be greatly influenced by the environment Khalafalla (1993).

5.2.3. Leaf area (cm^2):

There was significance deference between cultivars same results reported by Radma (2004) and contrasted with Amani (2013) The observed deferences can be attributed to genetic as well as environmental factor, most of the crosses showed positive percentage heterosis for leaf area index indicated that leaf area index was inherited in a highly heterotic manner Khalafalla (1993).

5.2.4. Stem dimeter (mm^2):

Results obtained no significant deference between all varieties, obtained different result because they used cowpea and clitoria intercropped with maize that increased crop diameter due to absorbed N_2-fixation fron the soil Amani (2013) and Randa (2013) this may indicate hybrids were more sensitive than open pollinated to change in the environment which occurred at Shambat location Khalafalla (1993). .

5.3. Yield and yield components:

5.3.1. Grain weight (gm)/cob:

No significance deference in Grain weight per cob was observed among the different genotypes for this trail at Shambat location, different to Amani (2013) and Khalafalla (1993) most of the crosses showed positive heterosis over mid-parent for grains yield per plant, attributed that the existence of a wide range of variability in the evaluated materials for this character.

5.3.2. 100 grains weight (gm)/cob:

The average 100-grains weight at Shambat was lower than Wad Medani. This was mainly due to the fact that the crop was subjected to water stress at this location. Most of the hybrids showed heterosis over the mid-parent for this character, confirming the findings of Khalafalla (1993).

The results showed no significance deference between varieties in100 seeds weight, since they are genotypic in nature, usually do not respond well to change in environment is the number of grains per kernel Gumaa (1999) and Hamid (2005).

5.3.3. Number of grains/cob:

All genotypes showed that was no significance deference in number of grains per cob, these results different to Khalafalla (1993) found the great amounts of variability in the tested materials in this character, indicating that this character was mostly controlled by non-additive gene action.

5.3.4. Number of rows/cob:

The genotypes exhibited no significance deference in number of rows per cob for this character this was different to Khalafalla (1993) reported wide range of of variability of kernel row number. Gorgan and Francis (1972) reported that kernel row number had little variation in most crosses.

5.3.5. Number of grains /line:

The results showed there high significant deference between al genotypes, the heighest number were Mugtama 45 and Sweet corn. Khalafalla (1993) reported similar results indicating the existence of a wide range of variability in the evaluated material for this character.

5.3.6. Grains yield t/ha:

Among six accessions of maize, there were significant deference in this character at Shambat location. The results obtained in this study revealed the existence of a wide range of variability in the evaluated material for this character. Similar findings were reported by many workers (Cross, 1990 and Khalafalla (1993). Means grain yield t/ha of most genotypes was higher at Medani than Shambat this may due to the reduction in 100-grain weight, which resulted from water stress at shambat. Yield is a complex character which is determined by many components, hence the relative importance of each of these components is determined by its contribution to the final yield. This study, Although a substantial amount of heterosis was expressed by most of the hybrid in number of grain per cob, heterotic effect in 100 grain weight were of small magnitude. Thus most of the heterosis in grain yield t/ha can be attributed to increase in number of grain per line rather than grain weight. This is agreement with the findings reported by (Cross, 1990 and Khalafalla, 1993).

It is worth to mention that Hudiba 2, Mugtama 45 and Sweet corn showed the highest heterosis at Shambat Khalafalla (1993) who reported that heterosis in maize appear to increase with the increase in genetic divergence of the parental populations.

Since there are significant deferences between genotypes in number of grains /line directly correlated to the end product of maize opposite results obtained by Radma (2004).

CHAPTER SIX

SUMMARY AND CONCLUSION

6.1. Summary:

Six maize genotypes of (Zea mays L.)evaluated on growth and yield and yield components at the college of agricultural studies during winter season of 2014. A Randomized Complete Block Design with three replicates was used .

Result showed that there was significant different in (Plant height 30 days and 45 days), (Leaf number 30days, 45days and 60days), Leaf area, Number of grains /line and grain yield t/ha.

6.2 Conclusion:

According to the results obtained in this study, it can be conducted that:

1. Genetic variability was existing in the material under the study; such variability can be exploited in different breeding programs.
2. Positive heterosis was detected at both hybrid and open pollinated genotypes.
3. Additive gene action was important in controlling the inheritance of Plant height, Leaf number, Leaf area, number of grains/line and grain yield t/ha.
4. The experiment should be repeated to another season to confirm the results.
5. Further studies with different more genotypes hypothesis.

References

Aoad- Moroco Primary Feasibility Study for Corn Production at Gezira Provice (Arabic Issue). Arabic Organization for Agricultural Development, 2006. Study for Corn Production Khartoum. Sudan Issue.

Castro, M.G., C.O. Gander, and J.H. Lonnquist. 1968. Cumulative gene effect and nature of heterosis of maize. Crop Sci.8:97-101.

Cross, H.Z. 1990. Diallel analysis of heterosis and combining ability in some Indian sorghum. Indian J. of Genetic and plant breeding. 30(1): 26-35.

Dawelbeit, S.A; F.M. Salih; O.A. Dahab; and S.E.H. Ahmed, 2007. Current Research in Fertilizer Use in Irrigation Agriculture in Sudan. 13th AFA International Annual Fertilizers Forum and Exhibition. SharmElseikh. Egypt.

Feber, W.R. 1987. Principles of cultivar development. I: Theory and technique. Iow State Univ.press.

Gargan, C.O. and C.A. Francis. 1972. Heterosis in inbred source of maize crosses. Crop sci. 12: 729-730.

Gumaa, A. H. A. 1999. Effect of Inoculum, Nitrogen and Phosphorous fertilizer on Grown and Yield of Three Guar *Cyamoposis tetragonoloba* (L.). Cultivars under irrigation. M.Sc.Thesis. University of Khartoum. pp168.

Hallauer, A.R. and J.B. Miranda. 1981. Quantitative genetics in maize breeding. Iow State Univ.

Hamid, S. A. M. 2005. The effect of salinity soil texture and reaction on nodulation of cluster bean and Clitoria. The 5th International GEAR Syamposium-cum-Workshop. Al_Baath University. Homs, Syria.

Hays, H.K., F.R. Ummer, and D.C. Smith. 1955. Methods of plant breeding. Mc Graw. Hill Book Co. NY.

Higgs, R.L., and W.A. Russell. 1968. Genetic variation in quantitative charactersin maize inbred lines. Crop sci. 8: 349-351.

Johanson, G.R. 1973. Diallel analysis of leaf area heterosis and relationship to yield in maize. Crop sci. 13: 178-180.

Khair, M.A.M. 1999. Principles of Forage Production (in Arabic) Agricultural Research Corporation. Wed-Medani. Sudan.pp220.

Khalafalla, M.M. 1993. Evaluation of Maize Genotypes (Zea mays L.) For General and Spacific Combining Ability. M.Sc. Thesis. Khartoum University College of Agriculture. Khartoum. Sudan.

Little.T.M. and F.J.Hill.1978.Agriculture Experimentation: Design and Analysis. John Willey and Sons. Inc- New York. USA. pp350.

Lonnquist, J.H. 1953. Heterosis and yield of grain in maize. Agron. J. 45: 539-542.

Nevado, M.E. and H.Z. Cross. 1990. Diallel analysis of relative growth in maize synthetics. Crop sci. 30: 549-552.

Nour, A.M.; M.E. Lazim; and A.A. Hashim. 2005. Effect of Nitrogen and Phosphorous on Growth and Yield of Maize. Processing of 37th and 38th Meetings of National Crop Husbandry Committee. 1-5 Wed-Medani. Sudan.

Rabih, Y.M.M. 2007. The effect of different phosphorous on growth and yield of Maize cultivas (Zea mays L.) under rained condition. M.Sc. Thesis. University of Khartoum.

Robison, H.F. and C.C. Cockerham. 1961. Heterosis and inbreeding depression in population involving two open pollinated varieties of maize. Crop sci. 1: 68-71.

Robison, H.F., C.C. Cockerham, and P.H. Harvey. 1955. Genetic variances in open pollinated varieties of corn. Agron. J. 41: 353-359.

Sindgi, S.S., S. Vishnu, and D. Singh. 1970. Variation and hretabilityof some quantitative character in F2 progenies of intervarietal crosses of sorghum. Indian J. of genetic and plant breeding. 30: 660-294.

Sprague, G.F. 1966. Quantitative genetics in plant development. Duphytica. 28: 287-295.

Sys, C. E.W. Ranst; J.Debavveye; and F.Beernaet. 1993. Land Evaluation. Part 3Crop Requirements. Brussels-Belgium-pp.201.

Zahir, Z.A.M., M.I.Navced, H.S.Zafar, M. Rahman, Arshad and M. Khalid. 2007. Evaluation of Compost Organic waste Enriched with Nitrogen and L. Tryptophan for Improving Growth and Yield of Maize.

Appendices

Appendix 1: The semi– desert climate:

Sun- shine duration	3650 hour/year
Solar radiation	22.7 MJ / m^2/day
Maximum temperature	42 c˚ (May)
Minimum temperature	12c˚ (January)
Temperature range	30c˚
Rainfall	100-250 mm/annum
Evaporation	2400 mm/ annum

Appendix 2: Chemical and physical properties of the field soil:

PH	8.0
ECC ds/m	1.7
SAR	6
Soluble cation (meq/1) Ca+Mg Na K	 0.9 1.0 0.2
CL meq/L	1.8
N%	0.08
P p.p.m	7
$CaCo_3$ %	2.00
Sand %	37
Silt %	15
Clay %	48

Appendix 3: ANALYSIS OF VARIANCE:

3.1. Plant height 30 days A.P:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	259.751	129.876	3.63
Replications	5	434.684	86.937	
Errors	10	239.662	23.966	
Total	17	934.098		

Coefficient of variation: 11.25 %

3.2. Plant height 45 days A.P:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	322.68	161.342	2.91
Replications	5	1192.62	238.525	
Errors	10	819.80	81.980	
Total	17	2335.10		

Coefficient of variation: 13.21%

3.3. Plant height 60 days A.P:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	1139.63	569.816	0.94
Replications	5	2139.30	427.860	
Errors	10	4527.76	452.776	
Total	17	7806.68		

Coefficient of variation: 16.51%

3.4. Leaf number/plant 30 days D.A.P:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	1.13778	0.56889	2.66
Replications	5	4.86444	0.97289	
Errors	10	3.66222	0.36622	
Total	17	9.66444		

Coefficient of variation: 10.33%

3.5. Leaf number/plant 45 days D.A.P:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	0.4578	0.22889	1.96
Replications	5	6.7578	1.35156	
Errors	10	6.9022	0.69022	
Total	17	14.1178		

Coefficient of variation: 10.37%

3.6. Leaf number/plant 60 days D.A.P:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	0.03111	0.01556	2.99
Replications	5	4.54444	0.90889	
Errors	10	3.03556	0.30359	
Total	17	7.61111		

Coefficient of variation: 4.72%

3.7. Leaf area (cm^2):

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	3010..8	1505.39	0.46
Replications	5	5290.0	1057.99	
Errors	10	22756.1	2275.61	
Total	17	31056.8		

Coefficient of variation: 46.67%

3.8. Stem diameter (mm^2):

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	28.994	14.4968	0.68
Replications	5	71.531	14.3062	
Errors	10	209.378	20.9378	
Total	17	309.902		

Coefficient of variation: 23.88 %

3.9. Grain weight (gm)/cob:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	47.674	23.8369	0.39
Replications	5	35.790	7.1580	
Errors	10	181.949	18.1949	
Total	17	265.413		

Coefficient of variation: 22.36%

3.10. 100 grains weight (gm)/cob:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	30.1344	15.0672	0.22
Replications	5	4.3161	0.8632	
Errors	10	38.7656	3.8766	
Tal	17	73.2161		

Coefficient of variation: 18.18%

3.11. Number of grains/cob:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	26901.2	13450.6	0.99
Replications	5	10709.2	2141.8	
Errors	10	21713.1	2171.3	
Tal	17	59323.5		

Coefficient of variation: 17.87%

3.12. Number of rows/cob:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	0.7081	0.35405	0.83
Replications	5	7.5680	1.51360	
Errors	10	18.1968	1.81968	
Tal	17	26.4728		

Coefficient of variation: 10.41 %

3.13. Number of grains /line:

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	78.180	39.0901	3.59
Replications	5	160.133	32.0265	
Errors	10	89.185	8.9185	
Tal	17	327.498		

Coefficient of variation: 15.12%**3.14. Grains yield t/ha:**

Source	Degree of freedom	Sum of square	Mean square	F value
Treatments	2	0.8954	0.4477	25.63
Replications	5	51.0313	10.2063	
Errors	10	3.9823	0.3982	
Tal	17	55.9090		

Coefficient of variation: 5.59 %