SUDAN UNVERSITY OF SCIENCE& TECHNOLOGY

College of Agricultural Studies

Variability Study of & in some Grain Sorghum (*Sorghum bicolor*L.moench)Genotypes for Growth and Yield Characters

A Dissertation submitted to the Sudan University of Science and Technology the partial Fulfillment of the Requirements for degree of Bachelor of Science in Agronomy.

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الاية

قال تعالي:

أَمَّنْ خَلَقَ السَّمَاوَاتِ وَالْأَرْضَ وَأَنزَلَ لَكُم مِّنَ السَّمَاءِ مَاءً فَأَنبَتْنَا بِهِ حَدَائِقَ ذَاتَ بَهْجَةٍ مَّا كَانَ لَكُمْ أَن تُنبِتُوا شَجَرَهَا أَإِلَـهٌ مَّعَ اللَّـهِ بَلْ هُمْ قَوْمٌ يَعْدِلُونَ ﴿٦٠﴾

الآية (60) سورة النمل

صدق الله العظيم

DEDICATION

To my mother (God mercy her)

To my father

To my brotherS

To my sisters

To my friend's

To my teachers

ACKNOWLEDGEMENT

I am deeply grateful to ALLAH who bestowed me good health and courage to accomplish this study. Wish supervisor Dr. Atif Elsadig Idris for his enormous assistance, guidance, criticism, advice and supervision through the progress of this study; thanks are also due to Ustaz/ Mohammed ALLazem and Ustaz Dagach and Dr. Mwahib for their continuous assistance to complete this research successfully. My full thank Are extended to the teacher and collogues in the Department of agronomy and in the collage of Agricultural studies. Finally, my deep thanks appreciation and gratitude due the member of my family whom have been more than help full.

ABSTRACT

A field experiment was conducted at the Experimental Farm of the College of Agricultural Studies , Sudan University of Science and Technology, Shambat during the winter season 2016-2017. By using Block Design (RCBD) with three replications. A twenty two sorghum genotypes were evaluated for growth, yield and its component. The results showed that were significant differences among sorghum genotypes for some growth, yield characters. The high weight of seeds(231g) and high yield, (1.39 t/ha), were obtained for the genotype (F3-6).Therefore, this genotype could be of high benefit in any sorghum breeding program for increase the yield .

ملخص الدراسة

أجريت تجربة حقلية بكلية الزراعة. جامعة السودان للعلوم والتكنولوجيا في الخرطوم (شمبات) في العروة الشتوية في موسم 2016 -2017 تم استخدام تصميم القطاعات الكاملة العشوائية بثلاث مكررات وتم اخذ اربعه قياسات نمو تشمل (طول النبات , وعدد الأوراق في النبات وعدد ايام الازهار وكما درست مكونات الإنتاجية وهي وزن البذور في النبات، ووزن ال100 حبة وإنتاج الغلة للهكتار.تم تقدير معامل التباين الوراثي والمظهري والارتباط بين الصفات المظهرية . اظهرت النتايج ان هنالك فروقات معنوية لكل الصفات المدروسة , سجلت اعلي نسبة تباين وراثي ومظهري واحرز الطرز الوراثي (F3-6) اعلي وزن للحبوب (231 جرام) مسجلا اعلي قيم انتاجية (1.39 طن/هكتار) ولذلك يمكن ان يكون ذو فائدة عالية في اي برنامج تربية ذرة رفيعة بهدف زيادة الانتاجية .

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CHAPTER ONE

INTRODUTION

Sorghum, *sorghum bicolor* (L.) Moench, ranks fifth in acreage of the cereal crops of the world , being exceed by wheat , rice , maize and barley (Anon, 1990) . Is an important cereal crop in Sudan . The grains Sudan grows 12-15 millions feddan annually . Average yield is estimated as 250 kg/fed in rain fed sector and 550 kg/fed in irrigated sector (Salah ,et.al.,2004).

Sorghum grains is the staple human food in many part of Africa and Asia and is one of sorghum grains include production of alcoholic beverages. Syrups and fuel. Also sorghum stalks are used in buildings, fencing and as forage for animals.

Sorghum is the major subsistence crop common cultivated in many parts of Sudan. It is the main staple food crop especially in rural areas. In many parts of the country the crop is wholly utilized. the grains are used for making kisra (unleavened bread from fermented dough) a significant portion is also used as thick porridge(Assida) . And it is used both as human food and animal feed. Most varieties grown are local i.e,(red and yellow) in addition to improved varieties i.e, Wed Ahmed and Tabat. will be to determine the genetic variability in different genotypes of sorghum including wild types, land races, cultivars, hybrids, pure lines, etc…by using field experiments. Any sorghum breeding program must be successful unless a wide range of variability is existed in the material under study. (Idris, 2012). Therefore the main objectives of this study are:

1. To study variability in twenty two grain sorghum for some yield and growth characters.

2.To select the most higher yield genotypeamong the studied genotypes.

CHAPTER TWO

LITERATURE REVIEW

2.1 Botany of sorghum

Sorghum belong to the family Poaceae, tribe Andropogoneae and subtribe Sorghinae (Dogget, 1988). Sorghum is self-pollinated with 2 – 20% outcrossing (Rai *et. al.,* 1999). Genus Sorghum is categorized into three species; *Sorghum halepense* (L.) Pers., and *S .propinquum* (K.) Hitch., are native tetraploid perennials of India and South-Eastern Asia . *Sorghum bicolor* (L.) Moench, 2n = 2x = 20 comprise of domesticated taxa derived from interbreeding domesticated sorghums and their closest wild relatives (Sally *et. al.,* 2007). Sorghumbicolor has a small genome (735 Mbp), larger than rice (389 Mbp) but smaller than wheat (16900Mbp) and maize (2600 Mbp) (Sally *et. al.,* 2007). The last genome duplication for *S . bicolor* genome could have occurred prior to the divergence of major cereals.

The genome of*S. bicolor* was successfully sequenced and information is utilized in enhancing understandingof evolution in cereals and diversity studies (Paterson *et. al.,* 2009). Information on wholegenome sequences propels development of molecular markers for precise genetic mappingand molecular study of genome structure and function (Elshire *et al.,* 2011). Domestication of sorghum started in East Africa, Ethiopia and the surrounding

countries in 1000BC (Dogget, 1988). Improved sorghum types then spread to other regions of Africa ,India, Middle East and America (Olembo *et. al.,* 2010). Cultivated sorghums evolved fromwild *Sorghum bicolor* subsp. arundinaceum (Dogget, 1988).

Cultivated sorghums are dividedinto five basic races: bicolor, guinea, caudatum, kafir, and durra, and ten intermediate racesof any two or more basic races (Harlan and de Wet, 1972).

Sorghum being an indigenous crophas evolutionary benefits associated with wide adaptability and tolerance to a biotic and biotic stresses common in Africa.

2.2 Economic importance of sorghum

Sorghum is the fifth most important cereal crop after wheat, rice, maize and barley in the world (Markus and Gurgling, 2006). The crop is a staple to more than 500 million people in arid and semi arid tropics in Africa and Asia (Charles et al., 2006). In Africa, about 25 million 2tons of sorghum are produced per annum and translates to one-third of the world crop

(FAOSTAT, 2008). In sub Saharan Africa, sorghum is primarily a crop of resource-poo r, small-scale farmers (Mace et al., 2009). In East Africa, sorghum has recently become an important industrial crop for the manufacture of beer and its starch has potential in bio-energy

production (Taylor, 2010). In Kenya, sorghum is ground into flour and mixed with other types of flour for baby food. Stalks are used for fuel, thatching huts and as animal feed (Charles et al., 2006).

Sorghum is cultivated in East and Horn of Africa where rainfall is intermittent and characterized by short periods of high rainfall (Charles et al., 2006). In East Africa, the crop grows well in a wide range of environments between 500 meters and 1700 meters above sea level with seasonal rainfall of 300mm and above. Sorghum is drought tolerant thus has become an alternative crop in several areas in Kenya like Eastern, Nyanza and Coast provinces where major staples like maize fail due to lack of enough rain (Taylor, 2010).

2.3 Origin and geographic distribution

It is generally agreed that cultivated sorghums arose from the wildSorghumbicolor subspecies averticilliflorum (Stead.) Piper (Doggett,1988). These wild forms were confined to Africa until recently, implying that domestication occurred in Africa .Both Doggett(1965)and Mann et al.,(1983) argued that the greatest variability in the crop and wild sorghums is found in the north-east quadrant of Africa (north of the equator , east of latitude 250E) and this was probably the centre of th first domestication , approximately 5000 years ago However ,Harlan and De Wet (1972), usi

archaeological ,palaeobotanical, anthropological and botanical evidence ,suggested that domestication occurred at different times in an area extending from the Ethiopian border, west through Sudan and up to Lake Chad

2.4.Variability in sorghum:

Selection of desirable genotypes for a certain character will not be effective unless considerable variability existed in the material under study (swarup and chaugale, 1962). Genetic variability is essential for effective plant breeding programmer. Sprague, (1966) and sindage et. al., 1970) in dictated that grain and fodder yield had the maximum genotypic variability while days to flowering had the least one. Progress in plant breeding depends on the extent of genetic variability present in population. Therefore, first step in any plant-breeding program is the study of genetic variability, which cannot easily be measured.

2.5. Correlations:

Correlations among characters are of in tarts to the breeder because they might help in identification of easily measured characters that could be used as in dictators for more important, but more complex, character. They are also useful in pointing out the possibilities and limitations of simultaneous improvement of desirable characters (Abdullah, 1991). Correlation among traits could be utilized to enhance the rate of selection response in the primary traits (Moll and stubbier 1974) and yield components (Gravies 1969). Yassin, (1973) attributed the association

among characters to pleiotropic or linkage, while Adams (1967) repotted that it was due to developmentally reduced relationship among components that were only directly the consequence of gene action.

CHAPTER THREE

MATERIALS AND METHODS

3. 1. Plant material

The plant material to be used in this study will be consisted of about 22Twenty tow sorghum genotypes as shown in Table (3.1). The 15 genotypes are exotic materials maintained in the Forage Improve Program – Shambat (FIP). 8 genotypes provided by the sorghum Breeding Program of Agriculture Research Corporation (ARC) - wed madani .

3.2 The experimental site:

The study conducted in the Experimental Farm of the College of Agricultural Studies , Sudan University of Science and Technology, Shambat (longitude 32º :31" E ; latitude (15º:39" N;altitude 380 m above sea level) during the winter of 2016/2017.

3.3. Description of Experimental of the study

The field experiments were used in this study , the field experiment during winter of 2017 was conducted at the Experimental Farm of the College of Agricultural Studies , Sudan University of Science and Technology, Shambat.

3.3.1 Field experiment

3.3.1.1 Cultural practices ,layout and experimental design:

The land was disc plough, disc harrowed and leveled by scraper to obtain a flat and fine seed bed. Ridiging was done at 0.70m spacing . Sowings were effected on 15/11/2016 for the winter sowings,The experimental design was randomized complete blocks design (RCBD) with three replications , four rows with 2m long and 70cm abart, 20 cm between hills and two plants were remained per hill . Five seeds were placed in holes spaced at 20 cm along the eastern side of the ridge and the seedlings were later thinned too approximately 2 plant/hole. Nitrogen fertilizer (urea46% N) was added at the second irrigation at rate of 80kg /fedan. No chemical can uses.. Irrigation was applied at 7 to 10 days interval. Weed population was kept at minimum by hand weeding.

The randomized complete block design (RCBD) was used in this experiment (GenStat,2011) .

3.4. Characters studied:

3.4.1. Measurements of growth attributes:

. Five plants were randomly selected from each plot after leaving 50% cm at each end of the plot. The selected plants were tagged. To avoid bird damage . the emerged heads on tagged plants were covered

by cloth bags. Data were recorded for the following parameters in the season.

3.4.1.2. plant height (cm):

Plants height was measured from the soil surface to collar of the last leaf on the plant, and then the mean plant height was calculated for each plot.

3.4.1.3. Leaves number per plant:

The five plants used for the measurement of plant height were also used for counting the leaves per plant and the average numbers of leave were recorded.

3.4.1.4. Number of Days to 50%flowering(days):

The number of days from emergence to the data when approximately 50% of the plants in the plot flowered

3.4.2 Grain yield and related traits

3.4.2.1. Grain yield (kg/ha)

Estimated in the AYT by harvesting heads representing 25% of area of each plot omitting the edge plants. The panicles were

covered by cloth bags prior to seed setting to avoid bird damage. At grain maturity, the panicles were harvested, left to dry in the lab, threshed in bulk and weighted. The grain yield per plot thus obtained was transformed to grain yield kg/ha.

3.4.2.2. Number of seeds /panicle:

Calculated by dividing the grain yield per plant by corresponding 1000 seed weight and then multiplied by corresponding 1000 seed weight and then multiplied by 1000.

3.4.2.3. 100 seeds weight(g);

Estimated from the bulk seed of the five plants chosen to obtain grain yield per plant. 100 seeds were randomly taken and their weight was recorded

3.5. Statistical analysis:

The analysis of variance (ANOVA) FOR Randomized complete blocks Design (RCBD) . with three replications was carried out on the collected data which analyzed by using Genestat version 4 software package, while correlation acquired by using (Genestat).

Table (1) Sorghum genotypes used in the study(2016-2017shambat

Entry code	Genotypes	Source
1	Tabat	*(FIP) – Shambat
2	Ajeb Sedo	(FIP) – Shambat
3	Abu Teman	(FIP) – Shambat
4	F. Wad AKAR	(FIP) – Shambat
5	SAR -2	(FIP) – Shambat
6	f3 -6	(FIP) – Shambat
7	SAR -6	(FIP) – Shambat
8	SAR -8	(FIP) – Shambat
9	SAR -9	(FIP) – Shambat
10	SAR -10	(FIP) – Shambat
11	SAR -11	(FIP) – Shambat
12	Serena	(FIP) – Shambat
13	f3 -13	(FIP) – Shambat
14	f3 -14	(FIP) – Shambat
15	Ajeb Sedo	(FIP) – Shambat
16	1.1.4	**(ARC) - wed madani
17	1.1.16	(ARC) - wed madani
18	2.13.5	(ARC) - wed madani
19	1.1.13	(ARC) - wed madani
20	Tabat	(ARC) - wed madani
21	W.Ahmad	(ARC) - wed madani
22	Gadam	(ARC) - wed madani

*Forage Improvement Program .Shambat Research Station,Suda

**Agriculture Research Corporation (ARC) - wed mada

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Growth characters:

4..1.1 Plant height (cm)

The mean of plant height data illustrated in table (2). The sorghum genotypes recorded the maximum highest mean values (194cm) . SAR- 2. On the other hand , the minimum height mean value (95cm) was observed on Gadam.The analysis of variance result indicated significance between genotypes in height mean values.Similar findings were reported by (Mohammed Marouf 2010). Khair, (1995).

4.1.5 Days to 50% flowering (days)

Significant differencewas reported on means for days to 50% flowering for sorghum genotypes in ranged between 65 – 89.6 days (tables) was highly significant Similar results were obtained by (Idris, 2006).

4.2 Grain yield characters

4.2.1. 100 seed weight (g)

The genotypes showed significant difference in the 100seed weight . the heaviest weight was obtained by SAR-10 found (4.66g) Sand the lowest weight was attained by Gadam found (2.16 g) This result are in agreement with Ibrahim (1997).

4.2.2. Grain yield (Ton/ha)

Thedataor result were shown the mean grain yield are presented

in table (2). The results revealed that the genotype (F3- 6) scoredtmaximumgrain yield (1.39 t/ha).Where as the minimum grain yield recodedby the genotype Gadam (0.78 t/ha). The analysis of variance results indicated a significance differences between genotype Similar finding were reported by (Mohammed, Marouf 2010). Khair, 1995.

Table: The mean performance of 22 Sorghum genotypes in Shambat winter season(2016/2017)

Var. Name	PH	Day50%	WS	NO.S	100GW	Yield/Ton/ha
Tabat	181.0	79.3	212.3	6156.7	3.42	1.27
Ajeb Sedo	142.6	83.6	191.6	4853	3.73	1.15
Abu Teman	158.0	72	226	5015.7	4.41	1.36
F. Wad AKAR	138.3	89.6	177.3	4472.7	3.87	1.06
SAR -2	194	69	184.6	5441	3.46	1.11
f3 -6	179	75.3	231.3	5381	4.21	1.39
SAR-7	176	67.3	175	5356	3.23	1.05
SAR -8	172.6	73.3	204.3	4598	4.35	1.23
SAR -9	156.6	79	203.3	5566.7	3.59	1.22
SAR -10	136.7	88.3	173.6	3697.3	4.66	1.04
SAR -11	58.67	93	180.3	5087	3.59	1.08
Serena	151.3	74	230	5124.7	4.42	1.38
f3 -13	124.6	84	140	4515.7	3.01	0.84
f3 -14	100	80	149	3735	4.15	0.89
Ajeb Sedo	133	84	175.3	4066.3	4.20	1.05
1.1.4	102.3	65	194.6	4223.3	4.52	1.17
1.1.16	112	68.6	151	4831.7	3.03	0.91
2.13.5	110.6	67	159.6	3750.7	4.20	0.96
1.1.13	100	79	180.3	3927.7	4.49	1.08
Tabat	102.6	81.6	181	4102	4.30	1.09
W.Ahmad	110.6	73.3	166.3	5407.3	3.03	1.00
Gadam	95.6	67.6	129.6I	5861.7	2.16	0.78
CV	**11.46**	**13.45**	**15.11**	**17.82**	**8.11**	**15.21**
LSD	**25.206**	**17.064**	**45.45**	**1403.8**	**0.5108**	**0.0933**
SE	**8.832**	**5.9789**	**15.925**	**491.89**	**0.179**	

CHAPTER FIVE

CONCLUSIONS

Based on the results Obtained from this study, it could be concluded that:

1.the wide range of variability obtained in the Study could beof argent value in any grain sorghum breeding program.

2.The high value of leaf area (465-4) and high yield; (1-94t/ha), were obtained for the genotypes (SAR)-8). Therefore, this genotype could be high benefit in any sorghum breeding program for increase the yield.

References

FAO, 1995. Production Yearbook. Vol. 49. FAO, RomeItaly.

Harlan, J.R. and De Wet, J.M.J. (1972). A simplified classification of cultivated sorghum. Crop Sci., 12: 172-17

Graufius, J.E. (1969). Stress: A. necessary ingredient of genotype by environment interaction. PP:346-355. In 2nd int. Barelt Genetics Symp.

Moll, R.H.and C. W.stuuber, C.W. (1974). Quantitative. Genetics. Empirical result relevant to plant breeding . Adv. Agron. 26: 313-317.

Poehlman, J.M. (1987). Breeding field crops rd3 Ed-An avi Boock. Published by van Nostw and Rejnhold. New York. PP. 508- 555.

Sindagi, S.S.:; V. Swarup and D.singh, (1970). Variation and heritability of some qualitative characters in f2 progrenies of intervarieted crosses of sorghum . Indian J.Gent. PL. Breed. 30:660-664.

Sprague, G.F. (1966). Quantitative genetics in plant improvement . Euphytica 28:287-295.

Yassin. T.E. (1973). Genetypic and phenotypic variances and correlations in faba bean (vicia fabaL.)J. Agric. Sci. (camb)81:445-448.

Douglas, D.B, lark, P.C, Stephen, R.C. and William F.B. (1983). Crop Science and food production .

Mohammed, S.S (2011).Geneic Diversity among some Sudanese sorghum Accessions using Molecuar Makers and phenotypic characterization thesis of Msc-Sudan Academyof Sciences.

Sasaki Takuji., Baltzar, AntonioA. (2009). Sorghum in sequence. Nature. 457:547-548. Doi: 10-1038/457547a.

Kambal, A. E. (1984). Comparative performance of some varieties of sorghum maize and pearl millet for Forage production in different season –Sudan Agric.J. 10: 61-64.

Ibrahim :O. E. L., obied (1997). Research and production of

dura sorghum in the Sudan. Annual Agricultural f0rum fedral Ministry of Agriculture. (in Arabic). Khartoum. Sudan.

Mohammed : M.1. (2007). Potential of locally developed Grain sorghum hybrids in the Sudan Scientific Reasrach and Essay 2: 330-337.

Idris. A.E.(2006). Evaluation of some lines of Grain sorghum (Sorghum bicolor L. Meonch) for hybrids production in the Sudan .A thesis submitted to the University of Khartoum in fulfillment of the requirements for the Degree of PH. D. in Agriculture.

Khair .M .A. M.; Ba Ibrahim and B.A. Mohammed (1995). Speed feed and Jumbo. New sorghum. Sudan grass hybrid for irrigated areas in central Sudan. A paper submitted to the variety Release committee. ARC. Wad medani. Sudan.

Daghsh, cereals crops, in Sudan yearbook 2012PP-97-102.

Gasim: S.A.And Gomez, A.A(1984). Statistical procedures for Agriculture research. 2nd .J. ohn wileya sons. Inc.NewYork, U.S.A.

Swarup,V.and D.S. chaugale. (1962). Studies on Genetic variability in sorghum .Indian J. Genet. 22:31-36.