International Research Journal of Emerging Trends in Multidisciplinary
ISSN 2395-4434
Volume 1, Issue 6 August 2015
www.irjetm.com

Comparative Study on Performance of Sorghum (*Sorghum bicolor* L.) Phenotype - barbarei- Grown under Different Environmental Conditions of South and Central Darfur States, Sudan.

[1]Ali H.Bahar; [2]Musa A.Ismail; [3]Abdelshakoor H.Sulaiman and [4]Siddig A. M. Ali

[1, 2, 3, 4] University of Zalingei, Faculty of Agriculture, Zalingei, Sudan

[1]alibahar9@yahoo.com

ABSTRACT

Two field experiments were carried out during 2001/2002 rainy season the first experiment was conducted in Tulus area (South Darfur State) on the cool season where sorghum (phenotype Barbarei) was grown by transplanting during the period from September to January. Seedlings were transplanted to the main plots during October and then seedlings were allowed to grow to maturity without supplementary irrigation. Three sowing dates 6th July, 16th July and 26th July were arranged in complete randomized design with four replications. Growth parameters (plant height, number of leaves and number of tillers per plant) showed no significant differences between different sowing dates, whereas differences were significant ($p \leq 0.05$) in yield parameters. The second experiment was carried out in Zalingei area (Central Darfur State) under rain fed. Complete randomized design with three sowing dates 6th July, 16th July and 26th July and three replications was used. The plot size was 25 m^2. Results showed significant difference ($p \leq 0.05$) in plant height in the fourth reading (75 days after sowing). Big number of leaves per plant was recorded on 26th July plants (7.6), which was significantly different from 6th July plants (6.33) and 16th July plants (5.60) for the first reading (30 days after sowing). Concerning leave area index, significant difference were observed. Other parameters measured showed no significant differences. Results showed that sorghum phenotype (Barbarei) failed to produce yield during the rainy season (July to November) although small heads were formed in some plants, this means that sorghum phenotype (Barbarei) is very sensitive to day light period.

Keywords: *sorghum, phenotype, rain fed, performance, Darfur*

1. INTRODUCTION

Commercial *Sorghum* species are originated in north-eastern Africa with domestication having taken place there around 5000 - 8000 years ago. The largest diversity of cultivated and wild sorghum is also found in this part of Africa. The secondary centre of origin of sorghum is the Indian Subcontinent, with evidence for early cereal cultivation dating back about 4500 years [1, 2, and 3].Cultivated sorghum moved from Ethiopia to West Africa at an early date, carried across Sudan to the region of Upper Niger River. The local farmers developed a diversified agriculture and numerous varieties of sorghum were produced [4]. Sorghum is an important crop worldwide used for food , fodder, production of alcoholic beverages and bio-fuels. Most varieties are drought and heat-tolerant especially important in arid regions where the grain is one of the staple food for poor and rural people. These varieties form important components of pastures in many tropical regions. *Sorghum bicolor* is the fifth-most important cereal crop grown in the world [5, 6, 7, 8, 9, 10, 11, and 12], and it had been, for centuries, one of the most important staple foods for millions of poor rural people in the semiarid tropics of Asia and Africa [11, 13, 14, and 15]. Sorghum is main staple food in Sudan, it is widely grown in both irrigated and rain fed areas. The cultivated areas of sorghum and millet in Sudan are about 84.65% of the whole cultivated areas in Arab world. Sorghum and millet production in Sudan is about 61.1% of whole production of Arab countries [16]. In Darfur region, sorghum is cultivated mainly in central (Zalingei, Mukjar, Garsela) and southern (Tulus,Tual) parts. Generally, the cultivation of sorghum in Darfur is concentrated on the lower terraces of the alluvial strata, where it is able to benefit from available soil moisture reserves during the wet and dry seasons [17]. The greatest diversity of cultivated sorghum genotypes is found in Darfur are classified either as Mareig (Sorghum durra), which is mainly used for brewing or Fasikh (Sorghum rigidum, which is used for flour. Both of these genotypes are late maturing (more than 150 days to maturity) but mareig is higher yielding genotype compared with fasikh genotype. The greatest diversity of sorghum genotypes cultivated in Sudan is attributed to the wide variation of climatic and soil factors and to the different uses of both grain and stalks. The sweet sorghum (forage sorghum) or also known as sorgos (*Sorghum saccaratum*) have juicy sweet stalks which used for forage and silage. At present time, more improved high yielding varieties introduced to Darfur region from both irrigated areas of Sudan (El-Gezira) like Tabat (hybrid) and from the rain fed areas (El

International Research Journal of Emerging Trends in Multidisciplinary
ISSN 2395-4434
Volume 1, Issue 6 August 2015
www.irjetm.com

Gadarif) such as Mugut, Dabar and other varieties, [17]. In the southern part of Darfur region, particularly in Tulus, Tual and Buram areas specific phenotype of sorghum is grown during the cool season without extra irrigation making use of available soil moisture. This phenotype is locally named Barbarei which characterized with intensive vegetative growth and high yielding capacity compared with both local and improved genotypes and varieties cultivated in Darfur area. Sorghum phenotype Barbarei is believed to be introduced to Darfur from The Republic of Chad, where is successfully cultivated around valleys during the cool season (October to February) [18]. The overall objective of this study is to compare the performance of sorghum (phenotype Barbarei) grown in different environmental conditions of Southern and Central Darfur States, Sudan.

2. MATERIALS AND METHODS

Two field experiments were carried out in two locations. The first experiment was conducted in Tulus area (South Darfur State) 90 km south of Nyala city during 2001/2002 dry cool season where sorghum (phenotype Barbarei) was grown without supplementary irrigation making use of residual soil moisture after the rainy season. The soil of the experimental area is clay loam soil flooded in the rainy season (June -September). Monthly rainfall in the two locations was shown in Table 1. The seedlings of sorghum (phenotype Barbarei) were prepared during September in well protected plots. Healthy seedlings were transplanted to the field plots on October after one month from sowing. Three sowing dates first of September, 10th September and 20th September were studied which were designated as D1, D2 and D3 respectively. Complete randomized design with four replications was used. The plot size was 5× 5 (25 m^2). Seedlings were planted in rows with spacing 70 × 50 cm. small holes were made to put the seedlings inside and then little water and soil added for best survival. No extra irrigation or fertilization was used. Plants were allowed to grow till full maturity. The parameters studied include plant height, number of leaves per plant, number of tillers per plant and yield. The vegetative growth records were taken once at flowering stage and yield was determined after harvest on January. The second experiment was carried out in Zalingei area (Central Darfur State), where sorghum bicolor (phenotype Barbarei) was grown under rain fed during 2001/2002 rainy season by direct seeding. The field located in the eastern part of Zalingei (Latitude 12^o 45; Longitude 23^0 29 and Altitude of 900 m above mean sea level. The soil is sandy loam changing to poor loam with depth [19].Seeds were obtained from Tulus local market. Three sowing dates 6th July, 16th July and 26th July according to the beginning of the rainfall designated as D1, D2 and D3 respectively were studied. Complete randomized design with three replications was used. The plot size was 5× 5 (25 m^2). Land was prepared using animal tracked local ploughs. Plants spacing was 70× 50 cm. The parameters studied include Plant height, Number of leaves per plant, Leave area index was calculated according to [20] and Stem diameter was measured by using Vernier Clipper [21]. The first measurements were taken one month after sowing and then two weeks interval was used for data collection. Data was statistically analyzed according to the standard procedure of complete randomized design as described by [22].

Table 1: Monthly rainfall in the two locations

Month / location	June	July	August	September	October	Total(mm)
Tulus	158.9	249.6	89.2	40.2	22.0	559.9
Zalingei	-	87.3	147.2	101.0	5.0	340.5

Note: Rainfall records in Tulus according to Tulus Meteorology Station, whereas, rainfall in Zalingei is according to the records of the rain gauge installed in the field.

3. RESULTS AND DISCUSSION

In first experiment, results in Table (2) revealed that no significant differences between sowing dates for all vegetative growth parameters studied. This may be due to that the appropriate conditions of sowing lasted all through the different sowing dates studied in this experiment. Concerning yield and yield components, significant differences were found between treatments ($p \leq 0.05$) as shown in Table 3. The third sowing date plants (D3) gave the highest 1000 seed weight (40.60 g), followed by (D1-38.38 g) then (D2 -35.58 g).This means that the latest sowing date (20th September) produced heavier seeds compared with the earlier sowing date (First September and 10 th September). This indicates that this type of phenotype (Barbarei) performs better when the season gets cooler. For seed yield (kg/feddan) results showed significant differences ($p \leq 0.05$) between treatments. The second sowing date plants gave the highest yield per feddan, followed by third sowing date plants and then the first sowing date plants, which showed the lowest yield per feddan.

International Research Journal of Emerging Trends in Multidisciplinary
ISSN 2395-4434
Volume 1, Issue 6 August 2015
www.irjetm.com

Table 2: Vegetative growth parameters of *Sorghum bicolour* (phenotype Barbarei) grown at Tulus Area (2001/2002 season)

Sowing dates	Plant height cm)	No. of leaves/plant	No. of tillers/plant
first of September (D1)	132.64 a	14.48 a	1.60 a
10th September (D2)	121.52 a	13.22 a	3.83 a
20th September (D3)	122.35 a	14.37 a	2.40 a
LSD 0.05	-	-	-
CV%	19.00	10.00	24.00

In each column: Means followed by the same letter (letters) are not significantly different.

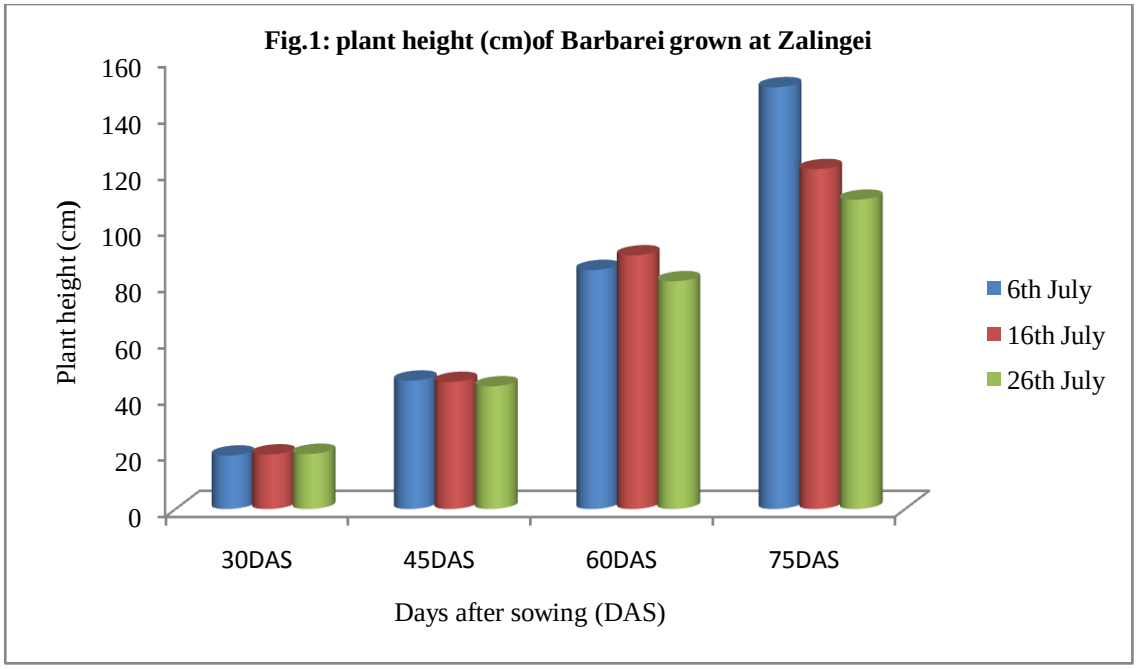
Table 3: Yield and yield components of *Sorghum bicolor* (phenotype Barbarei) grown at Tulus Area (2001/2002 season)

Sowing dates	1000 seed weight(g)	Seed yield (g/plant)	Seed yield (kg/feddan)
first of September (D1)	38.38 b	69.29 c	1164.10 c
10th September (D2)	35.58 c	82.51 a	1386.14 a
20th September (D3)	40.60 a	76.18 b	1278.74 b
LSD0.05	2.07	2.73	45.82
CV%	8.00	5.08	5.08

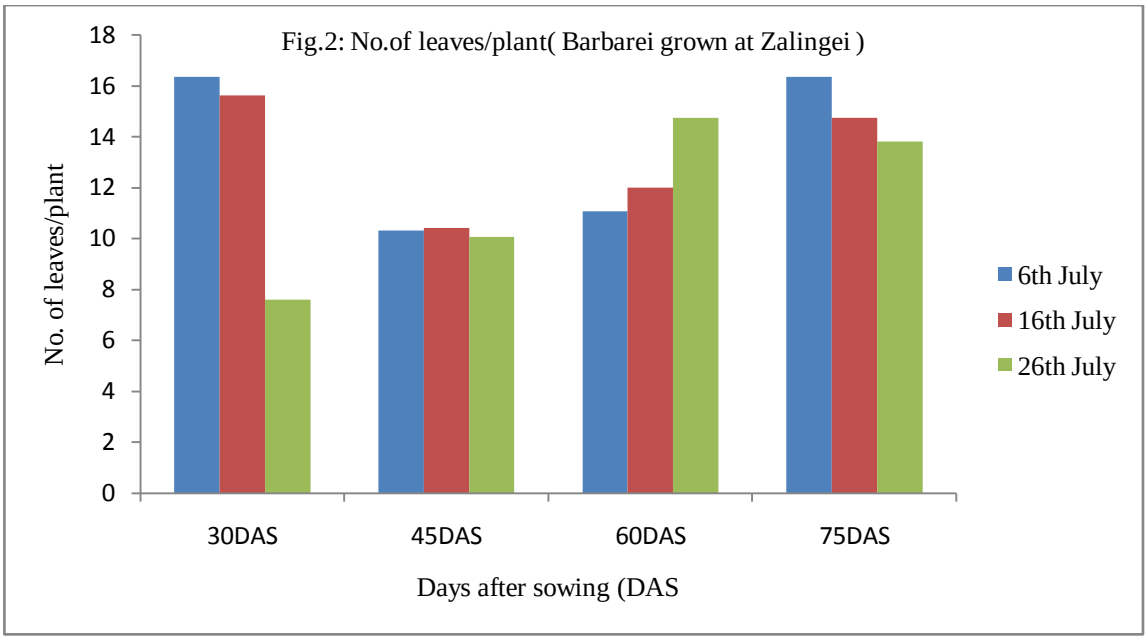
In each column: Means followed by the same letter (letters) are not significantly different.

In the second experiment (Zalingei area), results showed significant differences ($p \leq 0.05$) for plant height at 75 days after sowing, while plant height at 30,45 and 60 days after sowing showed no significant differences. The tallest plants (150cm) were observed in first sowing date plants, whereas the shortest plants were observed in third sowing date plants as illustrated in Fig.1. This could be attributed to the availability of the soil moisture during this period (6 July to 20 September) the amount of rainfall was enough for best sorghum (phenotype Barbarei) vegetative growth, whereas both second sowing date plants (120 cm) and third sowing date plants (110.6cm) faced shortage of rainfall at the end of vegetative growth. Results showed significant differences ($p \leq 0.05$) for number leaves per plant after 30 days from sowing, where third sowing date plants (D3) showed the highest number of leaves per plant (7.6) while no significant differences were noted according at 45, 60 and 75 days after sowing Fig.2, this could be due to the moisture availability before 6th August and 16th August respectively.

Fig.1: plant height (cm)of Barbarei grown at Zalingei



International Research Journal of Emerging Trends in Multidisciplinary
ISSN 2395-4434
Volume 1, Issue 6 August 2015
www.irjetm.com



Results in Table (4) showed no significant differences between different sowing dates for stem diameter whereas, significant differences ($p \leq 0.05$) were found in leave area index. First sowing date plants gave the highest leave area index (0.096) followed by second sowing date plants (0.074) and then third sowing date plants (0.072), this might be returned to the availability of soil moisture at first sowing date. *Sorghum bicolor* (phenotype Barbarei) grown at Zalingei area under rain fed (July to October) failed to produce seeds although small heads were seen on some plants. No pollens were observed. This crop is successfully cultivated in Western and southern Darfur during the cool season (September to January) without irrigation .This could assure the fact that this sorghum phenotype is more sensitive to affect of day light duration.

Table 4: Stem diameter and leave area index of *Sorghum bicolor* (phenotype Barbarei) grown at Zalingei area under rain fed condition (2001/2002 rainy season)

Sowing date	Stem diameter (cm)	Leave area index
6th July (D1)	3.30 a	0.096 a
16th July (D2)	2.71 a	0.074 b
26th July (D3)	3.19 a	0.072 b
LSD 0.05	-	0.003
CV%	16.0	2.5

In each column: Means followed by the same letter (letters) are not significantly different.

4. REFERENCES

[1] Food and Agriculture Organization of the United Nations.1995.Sorghum and millet in human nutrition

[2] Salah, M; Elsafi, M. and Nafisa, E. 2004. Efficacy of Apron star 42WS on control of covered and loses head smuts in sorghum. In: Proceedings 70th Meeting of the Pests and Diseases Committee. Pp.64.

[3] Food and Agriculture Organization of the United Nations. (FAOSTAT) Retrieved 2010-05-21.

[4] Dogget H. (1970) Sorghum. Longman, Western Printing Servives. London 403p

[5] Mutegi, E. (2010).Eco-geographical distribution of wild weedy and cultivated *Sorghum bicolor* (L.) Moench in Kenya: implications for conservation and crop-to-wild gene flow. *Genetic Resources and CropEvolution*.57(2):243-253.http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200026333.

[6] U.S. Grains Council. 2005. Sorghum Handbook.

[7] ICRISAT, India. December 2007.Industrial Utilization of Sorghum in India.

[8] United States Grain Council. November 2010. Sorghum.

[9] Rajulapudi, S. India beats China in sorghum production. The Hindu. Retrieved 17 March 2014. *Sorghum, a crop of substance*.http://resourcespace.icrisat.ac.in/filestore/1/0/3/7

[10] Agricultural Resource Marketing Centre - partially funded by U.S. Department of Agriculture Rural Development Program.General Sorghum. 2011.

[11] Daniel Z. and Maria H. 2000. *Domestication of plants in the Old World*, third edition (Oxford: University Press). p. 89.

[12] Ali H. B.; Kamal I. A.; Adam A. M.; Abdulmutalab M. K. and Siddig A. M. A. 2013. Assessment of Botanical Features and Crop Field Potentialities of (*Sorghum bicolo*r L. (Moench) Specific Phenotype (Barbarei) In South Darfur State, Sudan. ARPN Journal of Agricultural and Biological Science VOL. 8. NO. 8.

[13] ICRISAT website. Sorghum *(Sorghum bicolor (L.)* Moench) and millets.

[14] ICRISAT website: Dry land cereals: increasing productivity to help end hunger.

[15] ICRISAT website. CRP 3.6: Dry land Cereals Consortium Research Program: Food security for the forgotten poor.

[16] AOAD .2001. Arab Organization for Agricultural Development. Food Security Annual Report (Arabic) Khartoum pp 44-86.

[17] Mirghani K.; Hassan A. Dinar and Ali H. Bahar.1999. Assessment of Agro bio-diversity in Darfur Region (Official Study) pp13-17.

[18] Omar A.; Mohammed A. And Malik O. 2001. Local Farmers Notes. Tulus. Southern Darfur State.

[19] Mohammed S. A. 2002. Effect of Nitrogen and Phosphorous Fertilizers on Growth and Yield of Pearl Millet (*Pennicetum glaucum L.*) on Two Soil Types under Rain Fed Conditions, PhD thesis . Faculty of Agriculture, University of Khartoum

[20] Marshall, J.K. 1968. Methods for Leaf Area measurements of Large and Small Leaf Samples. Photosynthetica 2 (1):41-47.

[21] Clement, H. F. 1980. Sugarcane Crop lodging and Crop Control. Principals and Practices. University Press. Honolulu, Hawaii, USA pp342-346.

[22] Gomez, K. A. and A. A. Gomez .1984. Statistical Procedures for Agricultural Research. Second Edition John Wiley and Sons. Inc. New York pp 680.