



Effects of Irrigation Intervals and Sowing Methods on Fresh and Dry Matter Yield of Two Fodder Sorghum Cultivars

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Abstract

A field experiment was conducted during the period from November (2010) to early January, (2012), in two consecutive seasons, in the demonstration Farm of the College of Animal Production, Sudan University of Science and Technology, at Kuku, to study the performance of two Sorghum Cultivars (*Sorghum bicolor*) "Abu 70" and (*Sorghum Sudanense*)_ "Garawia" on a saline soil under four irrigation intervals 7-10-14-21 days, on two different land preparation methods (ridged and flat). Irrigation water supply was from domestic water supply net work. The treatments were arranged in a Randomized Complete Block Design (RCBD), with four replications, the data were subjected to statistical analysis using, MSTAT, Computer program. The main parameters measured were fresh and dry matter yields were taken 70 days after sowing. The crop factor (kc) was taken using CROP WAT Program .based on Penman Monteith equation for Khartoum area. The results showed higher dry matter yields for shorter intervals 7, 10 days, with significant differences. The shorter irrigation intervals showed higher yields for the different soil preparation methods, with significant differences. The interaction between the two crops, the interaction between intervals and soil preparation method followed the same pattern. All growth parameters for the two crops and under the two soil preparation methods gave significant differences in favor of the shorter irrigation intervals.

Keywords: Irrigation intervals, Fodder sorghum, Sorghum dry matter yields

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Introduction

Khartoum State is an important area for fodder production to satisfy the requirement of increasing animal numbers for meat and dairy products, the demand for which is continuously increasing due to normal population growth and mass immigration of rural communities to the capital towns and

other settlements. In addition to this, a remarkable activity for cattle and sheep for export has resulted in increasing the area of fodder crops. Irrigation cost and management, no doubt, plays an important role for the production of fodder crops. Efficient utilization of the land water resources will therefore be reflected directly to the interest

of the farmers, the consumer, and also to the interest of export trade, so that the irrigation interval can be added to the original Penman Montith Model which was recommended by the Food and Agriculture Organization of the United Nations (FAO, 1984). The area under Abu Sabein is estimated to be about 6300 ha (15000 Fadden) / year, (Abu Swar, 2005). This fodder is usually cut and transported to dairy animals, fattening or export animals before their journey abroad. This fodder is usually consumed as fresh matter. The fodder is a rich source of nutrient containing 5% crude Protein and 55 % total digestible nutrient (Osman *et al* 1968). A series of experiments started since 1975 and continued to 2005, to give complementary information relating crop productivity to irrigation level and variation to climate (Saeed, and EL Nadi, 1988). Forage production and consumption in Sudan is increasing over time due to the increasing rate of livestock population (140 million head) (Ministry of Animal Resources, 2007) and the diminishing amount of fodder produced naturally due to the expansion of rain-fed agriculture on the expenses of range land, also the highway roads , housing, pipelines construction. According to the recent survey conducted by Khair and Salih (2007), the amount of forage crops produced in Sudan was estimated at 971 thousand tons of dry matter which was produced from a cultivated area of 121 thousand hectares. The main forage crops produced in the country were Abu sabein *Sorghum bicolor* L Moench cv constituting about 43% of the total annual yield occupying an area of 70 thousand hectares . No wonder if forage sorghum can be produced in all types of soils as it is tolerant to salinity and sodicity. Sorghum (*Sorghum bicolor*_L.Moench) is a crop of world –wide importance. The tremendous increase in demand for animal products has led to great expansion in the area allocated for fodder crops. Sorghum is the most important irrigated forage crop in the

Sudan. The traditional sorghum cultivar (Abu Sabein) is the most important cultivar grown for forage in the Sudan. In Khartoum State, it represents more than 60% of the total area cultivated. Abu sabein is the Arabic name of *Sorghum bicolor* L Moench cv, which comes from the period the crop takes to reach the cutting stage at (70 days) (Kambal, 2003). Kambal (2003) also reported that the name Abu sabein is used for sorghum grain in the Rubatab and Alyab area of northern Sudan. In recent years the identification and use of forage plants from the semi -arid saline areas of the Northern region of Sudan has become increasingly important economically and particularly ecologically. Sorghum is the fifth most important cereal crop in the world and is the dietary staple for more than 500 million people in more than 30 countries. Sorghum is a water efficient crop which makes it an important cereal in semi-arid and arid environments where water is the main limiting factor of production. However, it must compete economically with other cereal crops, and to meet this challenge, the yield of sorghum must increase significantly (Alikhani *et al* 2012). Therefore, the objectives of these studies were to investigate the effects of different irrigation intervals and the two seedbed preparation methods on performance of sorghum forage.

The main objective of this work is to study the performance of two fodder crop cultivars mainly "Abu 70" and "Garawia", on saline soil, under different irrigation intervals, and two types of land preparation methods.

Materials and Methods

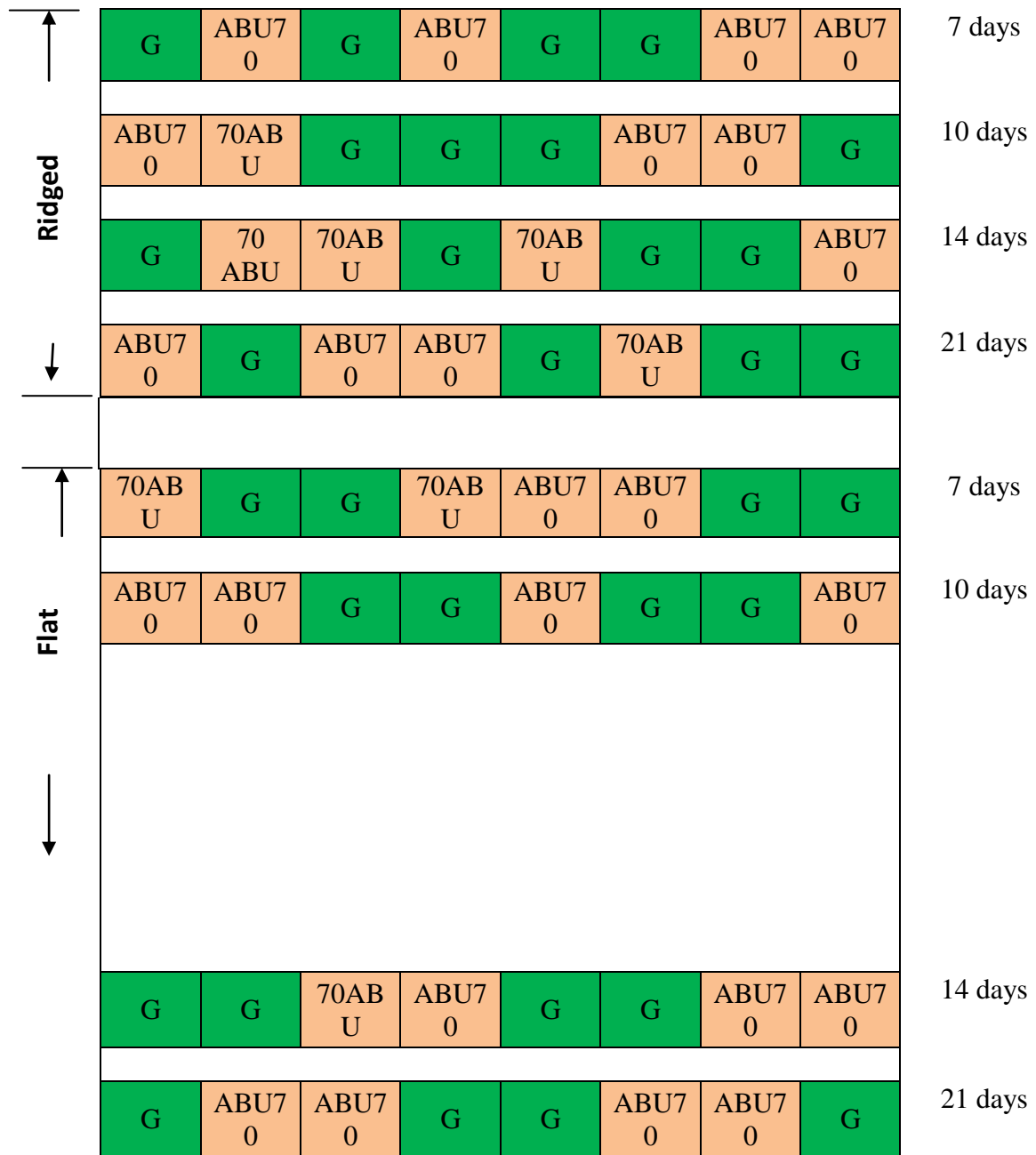
The study was conducted at the Demonstration Farm: College of Animal Production Science and Technology; Sudan University of Science and Technology Sudan - Kuku - for two consecutive seasons: November 2010 - 2011- October 2012. The study area lies in Khartoum North. latitude 15.40 N longitude 32.32 E and altitude 380

meters above mean sea level (msl). (Oliver 1965). The soil of the experimental site is clay (fine montmorillonite, hyperthermidentic chromusterts. Initial chemical and physical characteristics of the soil (0-60 cm) were collected from the experimental site. The soil recorded E_{c_e} above 4.4 ds / m slightly saline soil. The climate of the locality is tropical semi-arid with low relative humidity, maximum temperature is about 40 °C in summer and 20 °C in cool season but night temperatures are lower (Oliver, 1965). The mean annual rainfall is about 160 mm. However, there is considerable fluctuation in annual rain fall from year to year (Adam, 2005).

The experimental field used had a total surface area of 1280 m² divided into 64 plots each 20 m² (4*5 m). These were divided into two sub-plots each having 32 plots, for two land preparation methods (ridged and flat) each (32 plots) divided into two sub-sub plots with 16 plots, sub-sub-plots were divided into four irrigation intervals (7-10-14-21 days), each replicated four times . Fig (1). Two cultivars of sorghum forage seeds were used ; *Sorghum bicolor* . L. Moench cv. Local breed Alyab. Abu sabein and *Sorghum sudanense* C F S H 30. Garawia.

The seed rate used for Abu sabein was local breed Alyab. 20 kg per fadden and 4 kg per

fadden for garawia CFSH 30. Two different Sorghum varieties (Abu sabein and garawia), four plots each, were broadcasted on ridges (0.7m between ridges) and all over the flat plots. A hand fork was used to cover the seeds. The effective sowing date is at the first irrigation which was given immediately after sowing. Subsequent irrigations followed. Urea (46% N) was applied as source of Nitrogen at 77 kg per fadden in two equal doses, applied over the plots at the second and fourth watering, at 200 g / plot per dose. By the end of the growing season and at maturity stage 70-days from sowing, one square meter area was harvested from soil surface in a randomized manner from the middle of each plots, for different irrigation intervals, the harvested plants were immediately weighed in Kg / m², for The total fresh yields, and then left to dry till a fixed weight was obtained for dry matter in (kg / m²). The data were analyzed by the analysis of variance (ANOVA), then the means comparison was made by the LSD. The analysis was conducted using the MSTAT PROGRAM.



KEY:

	GAR
	ABU70

Figure 1: Experimental field lay out

Results and Dissection

Generally prolonging the irrigation interval decreased the values of the attributes measured. Comparatively higher yield in short intervals can be attributed to the relatively lower salt concentration at the end

of the interval. As the interval becomes longer the effect of salt concentration at the end of the interval becomes more profound on yields. As a result the longer intervals tend to give lower dry and fresh yields. Abu 70 on ridged and flat plots a score a higher dry

matter yields in kg per ha under different irrigation intervals, as seen in Table (1).

Table 1: Yield (DM) in kg per hectare of Abu 70 on ridged and flat plots for all intervals in the first and second season

Intervals	7 days	10 days	14 days	21 days
Ridge (first season) (t/ha)	9300 c	10600 b	9300 b	8800 a
Flat (first season) (t/ha)	7300 d	8500 c	7500 c	1300 b
Ridge (second season) (t/ha)	14500 a	13000 a	11500 a	10000 c
Flat (second season) (t/ha)	11000 b	9000 c	7500 c	2100 d

On the first season, it can be seen that the 10 days intervals scored higher yield on ridge plots. In the second season Abu 70 yield on ridged plots under 7 days interval gave higher dry matter yield as shown in Table (1). Ridging reduce the salt concentration at plant root level. Garawia on ridge and flat plots dry matter yield in kg per ha under different

irrigation intervals , on two seasons as shown in Table (2), the first season it can be seen that the 7 days intervals gave higher yield on ridged plots. In the second season Garawia yield on the ridged is shown in Table (2). It can be seen that the 7 days interval gave higher yield on ridged plots, as shown in Table(2).

Table 2: Yield (DM) in kg per hectare of Garawia on ridged and flat plots for all intervals in the first and second season

Intervals	7 days	10 days	14 days	21 days
Ridge (first season) (t/ha)	10000 a	9100 a	7300 a	3200 d
Flat (first season) (t/ha)	8500 b	8400 b	6500 b	5300 b
Ridge (second season) (t/ha)	10500 a	8000 c	7500 a	4000 c
Flat (second season) (t/ha)	7000 c	6000 d	3500 c	7000 a

Table (3) revealed the results of crop varieties, land preparation methods and irrigation intervals for the two seasons, the first season showed no differences. In the second season Abu 70 on ridged treatment scored higher yields than Garawia on flat. A significantly different yield at (0.5% level) for Abu 70 was observed in the two seasons. However, the two cultivars in the second season gave higher yield than in the first season. The fresh weight was observed to be influenced by irrigation intervals in both seasons. The maximum fresh yield was obtained by shorter intervals 7-10 days. These findings are in agreement with Mustafa and Abdel Magid 1982), Izzeldeen et al, (2000), Babiker (1995) and Ghsemi *et al* (2012) . Fresh fodder at harvest increased with decreased watering intervals. These results

were observed by Saeed (1984) for Abu sabein and lucern. He found that higher yields of fresh fodder in all sampling occasions were associated with frequent irrigations and the yield decreased as the irrigation intervals were prolonged. The trend for dry weight was similar to that reported for fresh weight, since dry weight represented between 20-25 percent of the fresh weight. (Hassan 1987) for soya beans, (Buck *et al* 1983) and Ishag (1982) .There were significant differences between ridged and flat soil preparation methods for Abu 70 and Garawia The ridged method showed differences throughout the irrigation intervals, and different land preparation methods in the two seasons. Recently, Saeed *et al* (2008) reported that the dry matter yield of lucerne irrigated every 7 and 10 days intervals was higher than yield of

lucerne under 13 days, intervals. The slight differences in the two seasons for the cultivars was attributed to the harvest ended

at early January when both temperature and relative humidity were low, a trend which is known in semi-arid regions (El Amin 1976)

Table 3: The effect of crops varieties, soil preparations methods, irrigation intervals for fresh yields (2011-2012) seasons.

Treatment	Fresh weight (t/ ha)	
	2011	2012
Abu70 ×F ×7 days	9.13	20.88 abc
Abu70 ×F ×10days	10.88	18.50bcde
Abu70 ×F ×14days	9.50	15.25dcde
Abu70 ×F ×21days	1.82	16.88 cde
Abu70 ×R ×7 days	11.63	27.00 a
Abu70 ×R ×10days	13.50	21.13ab
Abu70 ×R ×14days	12.00	19.38abc
Abu70 ×R ×21days	11.50	16.88bcde
Garawia×F×7 days	11.38	12.50bcde
Garawia×F×10days	10.88	11.75bcde
Garawia×F×14days	8.63	5.75 de
Garawia×F×21days	6.75	11.75bcde
Garawia×R×7 days	12.75	18.38 ab
Garawia×R×10days	12.88	13.88 abc
Garawia×R×14days	9.63	13.63 bcd
Garawia×R×21days	4.25	8.50 e
F .V	1.322 ^{ns}	3.269*
C.V%	49.28	10.12
L.S.D	1.722	0.568
S.E	2.419	0.797

Means having the same subscripts within a column for each season shows no significant different at 5% level.(LSD).

Conclusions:

1- From the results of this study, the following conclusions are drawn:

The regular shorter irrigation intervals (7 and 10 days) resulted in higher fresh and dry matter yield than under longer irrigation intervals.

2-Sorghum bicolor Abu 70 showed a higher fresh and dry matter yield than Sorghum sudanense Garawia due to some physiological and botanical factors.

Recommendations:

- 1- Irrigation every seven to ten days was the best for forage sorghum.
- 2- Sorghum forage on ridge land was better and should be used at the moderately saline soils.

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اثر فترات الري المختلفة وطرق الذراعة في انتاجية المادة الرطبة و الجافة في نوعين من علف الذرة

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المستخلص:

اجريت التجربة الحقلية خلال الفترة من نوفمبر 2010 الي اوائل يناير-2012، خلال موسمين متتابعين ، في المزرعة التجريبية لكلية علوم وتكنولوجيا الانتاج الحيواني جامعة السودان للعلوم والتكنولوجيا-كوكو- لدراسة اداء محصولي علف ابوسبعين والجراوية في ارض ملحية تحت ظروف ري علي فترات مختلفة 7-10-14-21 يوما في مهد مستوي و مهد مخطط (سرابات) مصدر مياه الري من شبكة مياه المدن . وزعت معاملات التجربه باستخدام تصميم القطاعات العشوائيه الكامله (R C B D) بأربعة مكررات تم تحليل البيانات احصائيا بواسطة برنامج MSTAT . اهم القياسات للحصول على الانتاجية الطازجة والجافة يتم الحصاد بعد 70 يوما من الزراعة . الانتاجية . تم استخدام معامل المحصول بالاستعانة ببرنامج ال CROP WAT لمنطقة الخرطوم باستخدام معادلة بنمان- مونتيت . اظهرت نتائج انتاجية الوزن الجاف تفوق الفترات القصيرة بين الريات 7- 10 يوما بفروقات معنوية. كما اظهرت الفترات القصيرة فروقات معنوية خلال معاملات طرق تحضير التربة وايضا المقارنة بين المحصولين . والتفاعل البيئي بين فترات الري وطرق تحضير التربة. اظهرت نتائج انتاجية الوزن الطازج نفس النمط الوارد في الانتاجية بالوزن الجاف . حيث تفوقت فترات الري القصيره 7 - 10 يوم . من خلال معاملات: فترات الري ، طرق تحضير التربة ، المقارنة بين المحصولين والربط بين فترات الري وطرق تحضير التربة . كما اوضحت نتائج التحليل للمحصولين خلال عمليتي تحضير التربة وفروقات معنوية لصالح وتفوق الفترات القصيرة بين الريات .