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Effect of Cutting Stages and Sowing Dates on Forage Yield and Quality of Sorghum (*Sorghum bicolor* L.)

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ABSTRACT

A field experiment was carried out at the city center of Ramadi during spring 2017 in field fallow one of farmer , to study the effect of cutting stage and sowing dates on forage yield and quality of sorghum . The experiment was using R.C.B.D with three replications in a split plot arrangement sowing data (20 march , 5 and 20 April) were taken a main plot, while cutting stages (vegetative , 50% flowering, and dough stage for seeds) were stages taken as the sub plot design , Results showed that the sowing date of 5 April gave a higher plant height (181.9 cm), green forage yield (42.8 ton.he^{-1}), dry matter (11.8 ton.he^{-1}) , yield of protein (1.5 ton. he $^{-1}$), yield of fiber (5.9 ton. he^{-1}), protein percentage (12.38 %). While the cutting at dough stage gave higher of each of plant high(204.6 cm) , yield green forage (38.20 ton.he^{-1}) , dry matter (12.6 ton.he^{-1}) , yield of protein (1.30 ton. he $^{-1}$) , yield fiber percentage (6.10 ton. he $^{-1}$) , fiber percentage (53.6 %).

INTRODUCTION

Population growth and inability of rangelands to support livestock needs enhance agronomists to pay more attention to develop cultivation of forage plants. Sorghum with good characteristics like high yield and tillering potential, rapid growth and high nutrient contents is most considered in arid and semiarid regions of the world (Ayub *et al.,* 2002). Multicut sorghum is capable of producing high-quality forage in mid to late summer when cool-season perennials have low production (Mohammed and Kadem,2010). Forage sorghum hybrid grass is an important livestock feed, often used to produced silage, hay or pasture during summer when adequate supply of moisture is available for the production of other crops (Nahayih, 2004). Timing and placement of N fertilizer have a major effect on the efficiency of N management systems.

Multicut sorghum forage should be fertilized more like an intensively managed perennial grass than a corn crop with N fertilizer being applied before planting and after each cut in a multicut system (Salunke *et al*., 2003). In irrigated areas, N fertilizer is very important and is the main factor affecting the DM yield of sorghum cultivars; N fertilizers are easily soluble and leach able in most of the soils, and increase the forage yield of sorghum varieties (Juskiw *et al.,* 2000). Multiple applications throughout the season have been suggested for optimum forage production of grass species (Schaffer , 1981). Studies of the yield response of forage multi cut sorghum hybrids developed for areas with shorter growing seasons to additions of fertilizer N have not been previously reported.

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In Iraq, a little information is available on the interactive effects of nitrogen on the quality and fodder yield of multi cut sorghum.

The objective of this research:

To determine optimum phase cutting gave yield higher and good quality. Also to determine planting data gave higher yield and quality and its interaction phase cutting with planting data on forage quantity and quality of sorghum.

MARTIALS AND METHODS

This experiment was conducted at in the form city center ALRAMADI by using hybrid sorghum bicolor seeds from cross variety KAFER with Sudanese crass during season 2017. The experiment was carried out using randomized complete block design RCBD with three replications , in arrangement of split plot design . Main plots were planting dates of D1 (March, 20th), D2 (April 5th) and D3 (April 20th) . while subplots included three cutting stages, C1: vegetative growth stage, C2 : 50%of plants flowers and C3: dough stage .The total number of treatments were 27 treatments. The soil of the experiment was cultivated and divided into experimental units each experimental unit has 6 lines along the 3 (m) line and the distance between the line was 50 cm. The seeds planted in a 5 cm depth, followed by nitrogen and phosphate fertilizer according to the required recommendations (1).

Traits studied: Plant height(cm), Green fodder yield(ton.he.$^{-1}$), The percentage of dry matter was calculated according to the following equation

% dry matter = $\frac{Dry\ sample\ weight}{Wet\ sample\ weight} x100$, Dry matter yield (ton.ha.$^{-1}$), by following equation (Green fodder yield x %Dry matter), crude protein yields(ton.ha.$^{-1}$), by following equation(Dry matter yield x %Raw protein), crude fibers yields(ton.ha.$^{-1}$) by equation(Dry matter yield x % crude fibers), %Raw protein by Biruret method , % crude fibers ,

The data were statistically analyzed according to the design used and the averages were compared using L.S.D. pro. 0.05 level. (Al-Rawi and Khalaf Allah, 1980) .

Table 1 - Average squares for planting dates and the rate of cutting stages of the studied traits

SOV	DF	Plant height (cm)	Green fodder yield (ton.he.$^{-1}$)	Dry matter %	Dry matter yield (ton.he.$^{-1}$)	crude protein yield (ton.he.$^{-1}$)	crude fibers yield (ton.he.$^{-1}$)	crude protein %	crude fibers %
Replication	2	24.42	3.16	2.20	4.20	0.82	0.50	0.88	0.25
planting dates(D)	2	414.16 **	3224.06 **	120.80 **	82.40 *	20.50 *	15.06 *	24.60 *	10.70 *
Error A	4	3.88	10.15	4.20	9.16	0.5	0.3	2.10	0.5
cutting stages (C)	2	4420.5 **	3730.5 **	456.30 **	110.5 **	60.30 *	68.11 **	50.19 **	4.30 **
D x C	4	**431.2	**155.6	**68.15	**620.2	2.20 n.s	**40.30	**22.6	**18.20
Error B	12	12.60	6.25	3.17	10.16	2.30	2.16	4.11	0.20

RESULTS AND DISCUSSION

Plant height:

The results of the analysis of variance (Table 1) showed significant differences in all the studied traits for both the planting dates, the cutting stages and interaction between the planting dates and the cutting stages which was non-significant for trait curd protein yield(t.he^{-1}). Table (2) indicates the height of the plant is higher (204.6 cm) higher rate of the giving (181.9 cm) for 5 April while the date gave March 20 (D1) the lowest rate of the gave (170.4 cm), this is due to favorable conditions for germination and growth in (D2). It is indicated from the same table that the stages of cutting significantly affected the height of the plant where the cut in the phase of the grains of (C3) significantly exceeded the all of the cutting stages, giving the highest rate of the trait was (204.6 cm) while the lowest rate of character in the stage of vegetative growth (C1) was 135.3 (cm), this is due to the age of the plant, the plant takes the chance to continue growing and elongation until it reaches maturity (Al-Dulimi,2012 and Al-Fahdawi,2011).

Green fodder yield

Table (2) indicates that there are significant differences in this characteristic according to the planting dates and the cutting stages. Where the highest rate was reached on the date of April 5 which reached (42.8 ton.he^{-1}) while the record of 20 March record of the lowest rate (24.6 ton.he^{-1}) due to its superiority in the height of the plant, which reflected positively on the outcome of green fodder .These results are agreed with (Al-Dulaimi et al,2010). The same table indicates that the cutting stages have a significant effect on the green fodder yield,

This was due to the increase in the number of leaves, plant height, stem diameter and the number of tillage, while the lowest rate was at the cutting stage C1 (26.6 ton.he.$^{-1}$). This results agree with what he has reached (Hussein *et al*,1979).

Table 2 - Effect of planting dates and stages of cutting and overlap between them on the height of the plant (cm) and the green fodder yield (ton.he $^{-1}$)

Green fodder yield(ton.he^{-1})				Plant height (cm)				Sowing date (D)
Catting stage				Catting stage				
Average (D)	C3	C2	C1	Average (D)	C3	C2	C1	
24.6	28.4	25.2	20.2	170.4	200.4	180.6	130.2	20 march
42.8	50.6	44.3	33.6	181.9	215.2	190.5	140.2	5 April
30.9	35.7	30.6	26.4	172.9	198.3	185.1	135.5	20 April
32.7	38.2	33.3	26.7	175.1	204.6	185.4	135.3	Average
D= 4.16 C= 2.55 DxC= 4.42				D= 2.57 C= 3.63 DxC= 6.28				L.S.D. 0.05

Percentage dry matter

Table (3) indicates significant differences between the dates of planting, as the dates of March 20 plants recorded the highest rate of that trait 29%, while the date plants recorded April 20 lowest rate of the trait of 24.5%. And the same table showed that the stages of the cut significantly affected the trait and excelled the plants that were cut in the stage phase of the grain of (C3) giving the highest rate of the trait amounted to 33.2% . The increase in the ratio of dry matter to plant growth in age is due to a decrease in the ratio of leaves to stems (Al-Dulaimi *et al*.,2010 and Al-Kalibi,1988). As for

the overlap between the planting dates and the cutting stages, the treatment D1C3 gave the highest overlap between the dates and the cutting stages of the percentage of dry matter reached 34.4%.

Dry matter yield:

The results of Table (3) indicate that there are significant differences in the dates of planting on the dry matter yield, as the dates of 20 April gave the highest trait rate (11.8 ton.h.$^{-1}$). While the dates of March 20 gave lowest dry matter yield (7.3 ton.he.$^{-1}$).The reason for the second date exceeded the superiority of the green fodder yield and plant height and this is agree with those of (Abdullah *et al*.2010 , Ayub *et al*.2002 and Ayub *et al.*1999). The same table indicates that there was a significant effect of the cutting stages on the trait, as the plants that cut C3 were superior and gave the highest rate (13.16 ton.he.$^{-1}$) this is due to the green fodder yield and the percentage of dry matter is the highest possible at this stage. As for the overlap between the planting dates and the cutting stages, the treatment D2C3 gave the highest overlap (15.2 ton.he.$^{-1}$)

Table 3 - Effect of planting dates and stages of cutting and overlap between them on Dry matter percentage and the Dry matter yield (ton.he $^{-1}$)

Dry matter yield (ton.he.$^{-1}$)				Dry matter percentage				Sowing date (D)
Catting stage				Catting stage				
Average (D)	C3	C2	C1	Average (D)	C3	C2	C1	
7.3	9.4	8.1	4.4	29.0	34.4	28.0	24.6	20 march
11.8	15.2	12.2	8.2	26.3	32.5	26.4	20.2	5 April
9.7	13.4	9.4	6.3	24.5	32.4	22.1	18.6	20 April
9.6	12.6	9.9	6.3	26.6	33.2	25.5	21.1	Average
D= 3.95 C= 3.26 DxC= 5.64				D= 2.67 C= 1.82 DxC= 3.15				L.S.D. 0.05

Crude protein yield:

Table (4) indicates significant differences between the dates of planting, as the dates of April 5 plants the highest rate of trait of (1.5 ton.he.$^{-1}$), while the date plants recorded March 20 recorded lowest rate of the trait of(0.7 ton.he.$^{-1}$), due to increase protein yield in this treatment to lowest dry matter yield and protein percentage this results agrees with those of (Cummins and Johnson,1981 ; Fakira,2001) .

The same table indicates the significant effect of the cutting stages on the trait, with the (C3) cutting stage giving it the highest rate of (1.30 ton.he.$^{-1}$), while the(C1) plants recorded the lowest rate of(0.9 ton.he.$^{-1}$). The reason for the superiority of stage (C3) is to increase the amount of dry matter. The results is agree with (Khrbeet and Saleh,2003). As for the overlap between the planting dates and the cutting stages, the results overlap non-significant.

Crude fibers yield (ton.he.$^{-1}$)

The results of Table (4) show that there is a significant effect of the dates of planting on the crude fiber yield, where the date plants (D2) with the highest mean (5.9 ton.he.$^{-1}$), while the date plants(D1) recorded the lowest rate (3.8 ton.he.$^{-1}$), the reason for the superiority of date plants D2 is to superiority in the of dry matter yield in addition to the high percentage of crude fiber these are agree with (Al-Dahiri,2010 ; Al-Jabouri *et al*.2002 and Almodares *et al*.2010). The table also showed

that there was a significant effect of the cutting stages on the trait as the cutting stage of (C3) gave the highest rate of crude fiber (6.1 ton.he.$^{-1}$), this is due to an increase in dry matter yield and dry matter percentage. These results are agree with the findings of (Ayub *et al.*1999 and Hamad,1986) . As for the overlap between the planting dates and the cutting stages, the treatment D2C3 gave the highest overlap(7.2 ton.he.$^{-1}$), while treatment plants D1C1 lowest rate gave (2.6 ton.he.$^{-1}$)

Table 4 - Effect of planting dates and stages of cutting and overlap between them on Ray protein yield (ton.he. $^{-1}$) and the Ray fibers yield (ton.he. $^{-1}$)

Crude fibers yield (ton.he.$^{-1}$)				Crude protein yield (ton.he.$^{-1}$)				Sowing date (D)
Catting stage				Catting stage				
Average (D)	C3	C2	C1	Average (D)	C3	C2	C1	
3.8	5.0	3.8	2.6	0.7	0.9	0.8	0.6	20 march
5.9	7.2	5.4	5.1	1.5	1.7	1.5	1.3	5 April
4.4	6.3	4.3	2.8	1.03	1.4	0.9	0.8	20 April
4.7	6.1	4.5	3.5	1.07	1.3	1.06	0.9	Average
D= 0.71 C= 1.50 DxC= 2.60				D= 0.92 C= 1.55 DxC= 2.68				L.S.D. 0.05

Percentage of ray protein:

Table 5 shows significant differences in the date of planting in the percentage of crude protein. The plants of treatment D2 recorded the highest percentage of the trait at 12.7%, while the date 20 April recorded the lowest percentage of the trait 10.2% these results are agree with those of (Hamad,1986 ; Hamad,2006 ; Khrbeet and Saleh,2003). The same table indicates that the stages of the cut significantly affected the trait as the plants of stage C1 with the highest percentage of the trait amounted to 13.3% while the of plants stage C3 gave lowest percentage of the trait amounted to 9.3%, this decrease with an increase in the formation of fiber content within the plant, while the C3 gave the lowest rate of the trait 9.3%. There was a significant overlap between the dates of planting and the stages of cutting which gave the highest rate of the trait of 15.3% in treatment D2C1 .

Percentage of crude fiber:

Table (5) showed that the sowing date of 20 April recorded the highest percentage of crude fiber percentage (51.6%) and differed significantly from the first date plants 20 march which recorded the lowest average rate (46.5%) , this is due to the effect of environmental conditions resulting from differences in temperature, where the higher the temperature leads to a decrease of protein content and accompanied by an increase in the percentage of fiber formed within the plant (Almodares *et al.*2010 ; Kassam and Andrews 1975). Table (5) shows the effect of the cutting stages affected significantly in the trait where the cut of plants in stage C3 exceeded the other of the stages and gave the highest rate of the trait was 53.6% and the lowest rate of the trait in the plants that were cut at stage C1 amounted to 43.3% , this is due to the low ratio of leaves to stems, in addition to poor in complex carbohydrate in sorghum (Al-Fahdawi,2010 and Lee, *et al.*1989). Table 5 shows significant overlap between the planting dates and the cutting stages, D3C3 giving the highest rate (56.5%.)

Table 5 - Effect of planting dates and stages of cutting and overlap between them on Percentage of ray protein and Percentage of raw fiber

Percentage of crude fiber				Percentage of crude protein				Sowing date (D)
Catting stage				Catting stage				
Average (D)	C3	C2	C1	Average (D)	C3	C2	C1	
46.5	50.2	48.2	41.1	11.3	9.0	12.0	12.6	20 march
49.1	54.1	50.3	43.0	12.7	10.5	12.4	15.3	5 April
51.6	56.5	52.4	46.0	10.2	8.4	10.2	12.2	20 April
49.6	53.6	50.3	43.3	11.3	9.3	11.5	13.3	Average
D= 0.92 C= 0.45 DxC= 0.79				D= 1.89 C= 2.07 DxC= 3.59				L.S.D. 0.05

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تأثير مراحل القطع ومواعيد الزراعة على حاصل العلف الاخضر ونوعيته للذرة البيضاء (*Sorghum bicolor* L.)

سلام تركي عسل

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المستخلص

نفذت تجربة حقلية في مدينة الرمادي في حقول أحد المزارعين خلال الموسم الربيعي 2017 وذلك لمعرفة تأثير مراحل القطع ومواعيد الزراعة على حاصل العلف الاخضر ونوعيته للذرة البيضاء استخدم تصميم RCBD وبترتيب الالواح المنشقة وبثلاث مكررات. خصصت الالواح الرئيسية لمواعيد الزراعة (20 آذار، 5 نيسان، 20 نيسان) بينما خصصت الالواح الثانوية لمراحل القطع وهي ثلاث مراحل (مرحلة النمو الخضري C1 ومرحلة 50 % تزهير C2 ومرحلة الطور العجيني للحبوب C3). اظهرت النتائج تفوق الموعد 5 نيسان في صفة ارتفاع النبات بلغ (181.9 سم)، وحاصل العلف الاخضر (42.8 طن.هـ$^{-1}$) وحاصل المادة الجافة (11.8 طن.هـ$^{-1}$) وحاصل البروتين الخام (1.5طن.هـ$^{-1}$) وحاصل الالياف الخام (5.9طن. هـ$^{-1}$) والنسبة المئوية للبروتين الخام (12.38%). بينما تفوقت مرحلة القطع عند الطور العجيني للحبوب C3 في ارتفاع النبات اعطت (204.6 سم) وحاصل العلف الاخضر (38.20طن .هـ$^{-1}$) والنسبة المئوية للمادة الجافة (33.2%) وحاصل المادة الجافة (12.6 طن.هـ$^{-1}$) وحاصل البروتين الخام (1.30 طن.هـ$^{-1}$) وحاصل الالياف الخام(6.10 طن.هـ$^{-1}$) والنسبة المئوية للألياف الخام(53.6%) .

الكلمات المفتاحية: الذرة البيضاء، مراحل القطع، مواعيد الزراعة، حاصل العلف، النوعية