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EFFECT OF CUTTING FREQUENCY ON YIELD AND QUALITY OF SOME SUMMER FORAGE CROPS

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ABSTRACT

This study was conducted at Sakha Agricultural Research Station during 1998 and 1999 seasons. The aim of this study is to determine the optimum cutting schedule (4, 3 or 2 cuts in 130 days) of forage sorghum (local hybrid-102), pearl millet (c.v. Shandaweel-1) and teosinte (local variety). Split-plot design was used, forage crops were allocated to the main plots, whereas number of cuts were in sub-plots.

The results indicated that forage sorghum produced highest total fresh and dry forage yield overall both seasons followed by pearl millet and then teosinte. Total yield of sorghum exceeded that of pearl millet and teosinte by (17.2, 5.8%) and (45.0, 26.1%) whereas pearl millet exceeded that of teosinte by 23.7, 19.2%) for fresh and dry forage yield, respectively.

Two cuttings systems (across species) produced highest total fresh and dry forage yield followed by three cuts and four cuts, respectively. Total yield of two cuts exceeded that three cuts and four cuts by (4.7, 22.2%) and (22.9, 42.8%), whereas three cuts exceeded that of four cuts by (17.4, 16.9%) for fresh and dry forage yield, respectively. The interaction effect was significant for fresh and dry forage yield.

Concerning chemical constituents, teosinte was higher in crude protein and lower in crude fiber and ash than forage sorghum or pearl millet. Increasing the number of cuts from 2 to 4 cuts increased crude protein (%) and decreased crude fiber (%). Ash content (%) fluctuated between forage crops or number of cuts.

At time of cutting (regardless cutting schedule) forage sorghum plants were tallest, thick with lowest leaf/stem ratio, whereas, teosinte plants were shortest, thin with highest leaf/stem ratio and pearl millet plants were intermediate. Increasing number of cuts from 2 to 4 cuts led to decreasing plant height, stem diameter and inversing leaf/stem ratio.

INTRODUCTION

Forage grasses, i.e. sorghum, millet and teosinte are considered to be the most important summer forage crops in Egypt, thus, fresh fodder during summer is of a limited supply. Therefore, great efforts have been directed towards the improvement of summer forage crops.

Moursi *et al.* (1967), found that as the age of sorghum increases, plant height increased, then total forage yield of sorghum increase (Caceres and Garcia, 1982). Knievel *et al.* (1971)**,** suggested that the time of cutting is important in yield and persistence of forage grasses. Koller and Scholl (1968)**,** reported that forage yield of sorghum was increased as cutting duration intervals increased. Meanwhile, Mannikar *et al.* (1976), found that as the date of the first cut was delayed the forge yield of sorghum increased. Umarov *et al.* (1978) obtained the highest yield of Sudangrass when plants were cut four times/year than three times/year and the highest yield of forage

sorghum was obtained when plants clipped after 40 or 50 days from sowing. Cutting frequency was found to be major factor to influence dry forage yield. Increasing cutting frequency caused a yield decrease (Middleton, 1983). Virendra Singh *et al.* (1988) found that single cut management was significantly superior over two cuts management of teosinte in forage yield but the reverse was true in herbage quality expressed as crude protein and digestibility. Rana *et al.* (1990), noticed that delaying the first cut of forage sorghum until 90 days increased yield of the first cut but decreased yield of the second cut. Total yields were lowest when the first cut was taken 60 days after seeding.

Nada and Jones (1983), reported that leaf/stem ratio in sorghum decreased at less frequent cutting. Burger and Hittle (1967), found that crude protein contents of fodder crops were higher when harvested four times compared with three times/year. George *et al.* (1968), reported that percent of crude protein, ash and fat decreased when harvests were delayed. At the same time, crude protein percentage decreased as plant height of fodder sorghum increased (Hernandez and Abiuss, 1970). Desai and Washko (1983), noticed that crude fiber content was higher in the first cut than in the late cuts in forage sorghum.

Meawed (1997) reported that, forage sorghum, in general, was tallest grass followed by pearl millet and at the last teosinte which was the shortest one. The same trend was taken for the stem diameter at the first cut. Stem diameter was increased as the duration intervals of the first cut increased. On the other side, it was generally, noticed that teosinte was the highest leaf/stem ratio compared with the other forage crops. Total fresh and dry forage yield ranked in the following descending order: forage sorghum > pearl millet > teosinte. Increasing duration intervals of cuts from 40 to 50 and 60 days caused significant substantial increase in fresh and dry forage yield.

MATERIALS AND METHODS

This present study was conducted at Sakha Agricultural Research Station (A.R.C.) during two successive seasons, 1998 and 1999. The experiment was laid out in a split-plot design with four replications. Three summer forage crops i.e. forage sorghum *Sorghum bicolor* (L.) Moench (local hybrid-102), Pearl millet *Pennisetum americanum* (L.) Leeke (Shandaweel-1 variety) and teosinte *Euchlaena mexicana* Schrad (local variety) were located in the main-plots. Three cuttings managements as a number of cuts i.e., 4, 3 or 2 cuts at long period of the growing season were arranged in the sub-plots. Forage yield was clipped according to number of cuts. Cutting after 40, 35, 30 and 25 days from sowing and from preceding cut, respectively, for the first treatment (4 cuts), 50, 45 and 35 days for the second treatment (3 cuts), and 70 and 60 day for the third treatment (2 cuts). The total period of the growing season for all treatments was 130 days.

The experiment was planted on the first week of June in both growing seasons. Plot size was 12 m^2 (3 x 4 m). Forge crops were broadcasted at 20, 15 and 25 kg seeds/fed for forage sorghum, pearl millet and teosinte,

respectively, according to the seed index and the recommended seeding rate for each crop. The experiment was fertilized with 20 kg. P_2O_5/fed added during land preparation and 90 kg N/fed splitted to 4 or 3 or 2 doses according to the number of cuts treatments added before the first irrigation and after each cut. Other cultural practices were applied as recommended.

The studied characters were fresh and dry forge yields at each cut and their total (kg./plot) and converted to ton/fed in both seasons and their combined for total yield. Some agronomic characters were recorded such as plant height (cm), stem diameter (cm) in both seasons and leaf/stem ratio in 1998 season. Chemical analysis of forage yield was done on dry matter basis (%) in 1988 season, to determine it's nutritive value (CP, CF and Ash as percent) according to A.O.A.C. (1980). Analysis of variances for the data collected were calculated as described by Steel and Torrie (1980). Comparison among the averages of treatments were made according to multiple range and multiple F-test (Duncan 1955).

RESULTS AND DISCUSSION

I. Forage yield (ton/fed):

a. Fresh forage yield:

Results presented in Table (1) showed significant differences between treatments at all cuts and their total in both seasons and their combined.

a.1. Forage crops effect:

Forage sorghum produced highest fresh yield at most cuts and their total in 1998 season followed by pearl millet and teosinte without significant differences. They gave 29.412, 18.159 and 19.378 ton/fed, respectively. While pearl millet produced highest total forage yield followed by forage sorghum and then teosinte with significant differences, which gave 36.135, 34.236 and 24.515 ton/fed, respectively, in 1999 season. As a combined over both seasons, forage sorghum was the best one, which gave 31.824 ton/fed followed by pearl millet (27.147 ton/fed) and teosinte (21.946 ton/fed). Total fresh yield of forage sorghum exceeded that pearl millet and teosinte by 17.2 and 45.0% whereas pearl millet exceeded that teosinte by 23.7%. These results are due to that forage sorghum had the tallest and the thickest plants, consequently, had highest forage yield. These results agree with that of Caceres and Garcia (1982) and Meawed (1997).

a.2. Number of cuts effect:

Data in Table (1) indicated that, two cuts treatment gave highest total fresh forage yield in 1998 season (23.567 ton/fed) followed by three cuts treatment (22.377 ton/fed) then four cuts treatment

(21.006 ton/fed). In 1999 season, no significant differences were recorded between two cuts and three cuts treatments (34.883 and 33.454 ton/fed respectively). while four cuts treatment produced lowest fresh forage yield (26.548 ton/fed) compared with other treatments with significant differences. As well as a combined data showed that two cuts treatment gave highest yield (29.225 ton/fed) followed by three cuts (27.915 ton/fed) and four cuts treatments (23.777 ton/fed) with significant differences. Total fresh yield of two cuts exceeded that of three cuts and that of four cuts by 4.7 and 22.9%, whereas three cuts exceeded that four cuts by 17.4%. Only, at 3rd cut in 1998 season, four cuts treatment gave higher fresh forage yield (6.475 ton/fed) than that of three cuts treatment (3.004 ton/fed), while insignificant differences between them in 1999 season. These results were in harmony with those obtained by Koller and Scholl (1968), Mannikar (1976), Middleton (1983), Rana *et al.* (1990) and Meawed (1997).

a.3. Interaction effect:

Data also showed that the interaction effect of the applied two factors (forage crops x number of cuts) of fresh forage yield was significant at all cuts and their totals in both seasons and their combined. Results clarified that the highest fresh forage yield for forage sorghum (A_1) and pearl millet (A_2) were obtained under two cuts management treatment (B_3) which produced 31.325 and 19.688 ton/fed in 1998 season, 40.163 and 39.069 ton/fed in 1999 season and 35.744 and 29.378 ton/fed as a combined analysis over both seasons. At the same time, in combined, there was no significant differences between treatments with a few increase of forage yield under two cuts treatment was the same.

b.Dry forage yield:

Results presented in Table (2) indicated that significant differences between treatments at all cuts and their total in both seasons and their combined. Generally, dry forage yield exhibited the same trend approximately as fresh forage yield.

b.1.Forage crops effect:

Forage sorghum gave highest total dry forage yield (5.299 ton/fed) in 1998 season, while pearl millet produced highest total dry forage yield in 1999 season (6.628 ton/fed). As a combined over both seasons, forage sorghum was the best crop followed by pearl millet then teosinte which produced 5.732, 5.420 and 4.546 ton/fed, respectively. Total dry yield of forage sorghum exceeded that pearl millet and teosinte by 5.8 and 26.1% whereas pearl millet exceeded that teosinte by 19.2%. Similar results were obtained by Caceres and Garcia (1982), and Meawed (1997).

b.2. Number of cuts effect:

Data showed that two cuts treatment gave highest total dry forage yield in 1998 and 1999 seasons and their combined which produced

5.538, 6.927 and 6.232 ton/fed, respectively. Four cuts treatment gave lowest total dry forage yield in 1999 season (4.488 ton/fed) and as a combined (4.365 ton/fed), meanwhile three cuts treatment gave intermediate total dry forage yield between them as following 6.171 and 5.101 ton/fed in 1999 and as a combined, respectively. Total dry yield of two cuts as a combined exceeded that of three cuts and four cuts by 22.2 and 42.8% whereas three cuts exceeded that four cuts by 16.9%. At the 1st and the 2nd cuts, two cuts treatment resulted in highest dry forage yield followed by three cuts treatment then four cuts treatments in both seasons. These might be due to the intervals between cuts of each treatment. These results are in agreement with those obtained by Koller and Scholl (1968), Mannikar (1976), Middleton (1983), Rana *et al.* (1990) and Meawed (1997).

b.3.Interaction effect:

Results showed a significant interaction effect of forage crops and number of cuts of dry forage yield at each cut and their total in both seasons and their combined. Generally, the highest total dry forage yield was obtained for each forage crop under two cuts management treatment (B_3) which gave 6.760, 7.870 and 7.315 ton/fed for forage sorghum (A_1) and 4.794,, 7.650 and 6.222 ton/fed for pearl millet (A_2) in 1998, 1999 seasons and in their combined, respectively. Whereas, highest total dry forage yield of teosinte (A_3) were obtained from two cuts treatment in 1998 season (5.058 ton/fed) and in combined (5.159 ton/fed) and from three cuts treatment in 1999 season (5.634 ton/fed) as shown in Table (2).

II. Chemical constituents (%):

The chemical components of forage yield i.e. Crude protein (CP), Crude fiber (CF) and Ash content as a percentage on dry matter basis of the three forage crops at each cut in 1998 season and the effect of number of cuts on these components were presented in Table (3).

a. Crude protein (CP):

Teosinte was higher in crude protein (13.63%) as an average than the other two forage crops (12.88% and 11.50% for forage sorghum and pearl millet, respectively). These results might be due to that teosinte was characterized by higher leaf/stem ratio than other crops. Concerning number of cuts, chemical analysis indicated that four cuts treatment had highest crude protein percentage (13.50%) as an average followed by three cuts treatment (12.63%) and then two cuts treatment (11.65%). Also, these results due to four cuts treatment which had the highest leaf/stem ratio followed three cuts and two cuts treatments.

b. Crude fiber (CF):

Forage sorghum and pearl millet had higher crude fiber content than teosinte at each cut and as an average overall cuts. They were 33.18, 33.48 and 30.73% for forage sorghum, pearl millet and

teosinte, respectively. Crude fiber decreased by increasing number of cuts overall forage crops. They were 31.50, 32.93 and 34.85% as an average for four, three and two cuts treatments, respectively.

c. Ash content:

There was slight fluctuating of ash content between forage crops and also between number of cuts treatment. They were 12.35, 11.85 and 11.68% as an average for forage sorghum, pearl millet and teosinte, respectively and they were 12.70, 12.03 and 11.35% for four, three and two cuts treatments, respectively.

These results of the chemical constituents are in agreement with those obtained by Burger and Hittle (1967), George *et al.* (1968), Harnandez and Abiuss (1970), Desai and Washko (1983) and Meawed (1997).

III. Agronomic characters:

Results presented in Table (4) for the agronomic characters i.e. plant height, stem diameter and leaf/stem ratio showed that there were significant differences between forage crops and also between number of cuts with few exception.

a. Plant height (cm):

Forage sorghum was the tallest grass at all cuts in both seasons, with significant differences except at the 4th cut in 1998 season which was without significant differences. While, teosinte had the shortest plants at all cuts in both seasons.

Concerning number of cuts, two cuts treatment gave the tallest plants overall forage crops at the first and the second cuts in both seasons. While four cuts treatment had the shortest plants. These results due to the intervals between cuts which more in two cuts treatment than other treatments. Similar results were obtained by Moursi *et al.* (1967).

b. Stem diameter (cm):

Data in Table (4) showed that forage sorghum had thickest plants whereas teosinte had thinnest plants and pearl millet was intermediate between them at all cuts in both seasons. With respect to number of cuts, significant differences between treatments were obtained except at the 3rd cut in 1998 season. Two cuts treatment gave the highest values of stem diameter at the 1st and the 2nd cuts in both seasons. These results, agreed with Meawed (1997) who found that stem diameter was increased as the duration intervals increased.

c. Fresh and dry leaf/stem ratio (%):

Data presented in Table (4) show that teosinte had highest fresh and dry leaf/stem ratio at all cuts in 1998 season except at the 4th cut which forage sorghum had the highest values. These results may be due to forage sorghum had tallest and thickest plants which led to decreased leaf/stem ratio, whereas teosinte had shortest and

thinnest plants, therefore, it had highest fresh and dry leaf/stem ratio. The 1st cut characterized with the highest fresh and dry leaf/stem ratio and then decreased gradually until the 4th cut.

Concerning number of cuts, data revealed that four cuts treatment had highest fresh and dry leaf/stem ratio at the 1st and 2nd cuts, while two cuts treatment had lowest values and three cuts treatment was intermediate between them. This may be due to plant height and stem diameter which were more at two cuts treatment than four cuts treatment. At the 3rd cut, the differences were not significant between four and three treatments. Leaf/stem ratio, also, decreased gradually from the first cut to the last cut. These results are in agreement with those obtained by Meawed (1997).

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تأثير تكرار الحش على محصول العلف وجودته لبعض محاصيل العلف الصيفية

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قسم بحوث محاصيل العلف ، معهد بحوث المحاصيل الحقلية ، مركز البحوث الزراعية

أجريت هذه الدراسة بمحطة البحوث الزراعية بسخا موسمى 1998-1999 بهدف معرفة أفضل عدد من الحشات (4 ، 3 ، 2 حشه) خلال موسم النمو (130 يوما) لبعض محاصيل العلف الصيفية وهى سورجم العلف (هجين محلى-102) والدخن (شندويل-1) والذرة الريانة (صنف محلى).

زرعت التجربة فى تصميم قطع منشقة ذات أربع مكررات حيث اشملت القطع الرئيسية على أنواع محاصيل العلف والقطع الشقية على عدد الحشات. تم دراسة كل من محصول العلف الأخضر والجاف (طن/فدان) والمكونات الكيميائية للمحصول كنسبة مئوية (البروتين الخام الألياف الخام الرماد) وبعض الصفات المورفولوجية للمحصول [ارتفاع النبات (سم) سمك الساق (سم) نسبة الورق/سوق (%)] وتتلخص النتائج فى الآتى:

أولا: كمية محصول العلف: أعطى سورجم العلف (الهجين المحلى 102) أعلى محصول علف أخضر وجاف على مستوى الموسمين يليه الدخن (شندويل-1) ثم الذرة الريانة (الصنف المحلى) حيث زاد محصول السورجم عن الدخن بنسبة 17.2 ، 5.8% ، وعن الذرة الريانة بنسبة 45.0 ، 26.1% وزاد محصول الدخن عن الذرة الريانة بنسبة 23.7 ، 19.2% كمحصول علف أخضر وجاف على الترتيب. ولقد أعطت المعاملة حشتين خلال موسم النمو أعلى محصول علف أخضر وجاف حيث زاد محصول الحشتين عن الثلاث حشات بنسبة 4.7 ، 22.2% وعن الأربع حشات بنسبة 22.9 ، 42.8% وزاد محصول الثلاث حشات عن الأربع حشات بنسبة 17.4 ، 16.9% كمحصول علف أخضر وجاف على الترتيب. وكان التفاعل بين أنواع المحاصيل وعدد الحشات معنويا.

ثانيا: المكونات الكيميائية: تميزت الذرة الريانة بارتفاع نسبة البروتين الخام وانخفاض نسبة الألياف الخام والرماد عن كل من سورجم العلف والدخن. ولقد أدت زيادة عدد الحشات من حشتين إلى أربع حشات إلى زيادة نسبة البروتين وانخفاض نسبة الألياف الخام. وكان التذبذب فى نسبة الرماد طفيفا سواء بين أنواع محاصيل العلف أو بين عدد الحشات.

ثالثا: الصفات المورفولوجية: تميز سورجم العلف بارتفاع النباتات وسمك الساق وانخفاض نسبة الورق/السوق فى حين تميزت الذرة الريانة بقصر النباتات ورفع الساق وزيادة نسبة الورق/سوق وكان الدخن وسطا بينهما. ولقد أدت الزيادة فى عدد الحشات إلى انخفاض فى ارتفاع النبات وسمك الساق وعلى العكس فى نسبة الورق/السوق.

Table (1): Fresh yield (ton/fed) at different cuts and their total in 1998 and 1999 seasons and their combined.

Treatment	1998					1999					Combined of total yield
	1st	2nd	3rd	4th	Total	1st	2nd	3rd	4th	Total	
Forage crops (A):											
Forage sorghum(A_1)	16.898^{a}	9.391^{a}	3.850^{b}	1.663^{c}	29.412^{a}	15.103^{a}	16.013^{b}	4.025^{c}	1.313^{c}	34.236^{b}	31.824^{a}
Pearl millet (A_2)	5.590^{b}	7.553^{b}	4.156^{b}	6.738^{a}	18.159^{b}	10.159^{b}	20.504^{a}	5.425^{b}	5.600^{a}	36.135^{a}	27.147^{b}
Teosinte	4.155^{b}	9.566^{a}	6.213^{a}	4.550^{b}	19.378^{b}	2.960^{c}	15.721^{b}	6.913^{a}	3.675^{b}	24.515^{c}	21.946^{c}
Number of cuts (B):											
Four cuts (B_1)	4.820^{c}	5.397^{b}	6.475^{a}	4.317	21.006^{c}	4.830^{c}	12.835^{b}	5.367^{a}	3.529	26.548^{b}	23.777^{c}
Three cuts (B_2)	8.638^{b}	10.735^{a}	3.004^{b}	-	22.377^{b}	8.692^{b}	19.222^{a}	5.542^{a}	-	33.454^{a}	27.915^{b}
Two cuts (B_3)	13.185^{a}	10.385^{a}	-	-	23.567^{a}	14.700^{a}	20.185^{a}	-	-	34.883^{a}	29.225^{a}
Interaction (AB):											
A_1B_1	9.573^{c}	6.300^{c}	5.250^{b}	1.663^{c}	22.785^{c}	9.170^{cd}	13.038^{d}	4.200^{bc}	1.313^{c}	27.720^{ef}	25.253^{d}
A_1B_2	18.550^{b}	13.125^{a}	2.450^{c}	-	34.125^{b}	14.438^{bc}	16.538^{cd}	3.850^{c}	-	34.825^{c}	34.475^{a}
A_1B_3	22.575^{a}	8.750^{b}	-	-	31.325^{a}	21.700^{a}	18.463^{bc}	-	-	40.163^{a}	35.744^{a}
A_2B_1	2.118^{f}	3.938^{d}	5.163^{b}	6.738^{a}	17.955^{e}	4.095^{de}	18.025^{bc}	4.288^{bc}	5.600^{a}	31.973^{d}	24.964^{d}
A_2B_2	4.498^{e}	9.188^{b}	3.150^{c}	-	16.835^{ef}	8.313^{cd}	22.488^{a}	6.563^{a}	-	37.363^{bc}	27.099^{c}
A_2B_3	10.150^{c}	9.538^{b}	-	-	19.688^{d}	18.025^{ab}	21.000^{ab}	-	-	39.069^{ab}	29.378^{b}
A_3B_1	2.765^{ef}	5.950^{cd}	9.013^{a}	4.550^{b}	22.278^{c}	1.225^{e}	7.438^{e}	7.613^{a}	3.675^{b}	19.950g	21.114^{e}
A_3B_2	2.870^{ef}	9.888^{b}	3.413^{bc}	-	16.170^{f}	3.325^{de}	18.638^{bc}	6.213^{ab}	-	28.175^{e}	22.173^{e}
A_3B_3	6.825^{d}	12.863^{a}	-	-	19.688^{d}	4.333^{de}	21.088^{ab}	-	-	25.419^{f}	22.553^{e}

Means designated by the name letter(s) are not significantly different at the 0.05 level according to Duncan's multiple range test.

Table (2): Dry yield (ton/fed) at different cuts and their total in 1998 and 1999 seasons and their combined.

Treatment		1998					1999					Combined of total yield
		1st	2nd	3rd	4th	Total	1st	2nd	3rd	4th	Total	
Forage crops (A):												
Forage sorghum	(A_1)	3.032^{a}	1.748^{b}	0.658^{c}	0.329^{c}	5.299^{a}	2.382^{a}	3.296^{a}	0.616^{b}	0.230^{c}	6.166^{b}	5.732^{a}
Pearl millet	(A_2)	1.086^{b}	1.828^{b}	1.001^{b}	2.070^{a}	4.213^{b}	1.519^{b}	4.119^{a}	0.997^{a}	0.976^{a}	6.628^{a}	5.420^{b}
Teosinte		0.704^{c}	2.216^{a}	1.555^{a}	1.034^{b}	4.300^{b}	0.441^{c}	3.418^{a}	1.126^{a}	0.546^{b}	4.792^{c}	4.546^{c}
Number of cuts (B):												
Four cuts	(B_1)	0.771^{c}	0.823^{c}	1.563^{a}	1.144	4.243^{b}	0.650^{c}	2.449^{c}	0.806^{b}	0.584	4.488^{c}	4.365^{c}
Three cuts	(B_2)	1.443^{b}	2.010^{b}	0.579^{b}	-	4.032^{c}	1.414^{b}	3.735^{b}	1.021^{a}	-	6.171^{b}	5.101^{b}
Two cuts	(B_3)	2.608^{a}	2.959^{a}	-	-	5.538^{a}	2.278^{a}	4.648^{a}	-	-	6.927^{a}	6.232^{a}
Interaction (AB):												
A_1B_1		1.324^{d}	0.933^{e}	0.966^{bc}	0.329^{c}	3.551^{f}	1.189^{c}	2.516^{e}	0.596^{b}	0.230^{c}	4.531^{e}	4.041^{f}
A_1B_2		2.874^{b}	2.361^{c}	0.351^{d}	-	5.586^{b}	2.426^{b}	3.035^{de}	0.637^{b}	-	6.097^{c}	5.841^{c}
A_1B_3		4.900^{a}	1.950^{cd}	-	-	6.760^{a}	3.532^{a}	4.337^{ab}	-	-	7.870^{a}	7.315^{a}
A_2B_1		0.516^{g}	0.668^{e}	1.376^{b}	2.070^{a}	4.454^{e}	0.557^{c}	3.315^{cd}	0.604^{b}	0.976^{a}	5.450^{d}	4.952^{d}
A_2B_2		0.893^{ef}	1.871^{d}	0.627^{cd}	-	3.390^{fg}	1.282^{c}	4.109^{b}	1.390^{a}	-	6.782^{b}	5.086^{d}
A_2B_3		1.849^{c}	2.945^{b}	-	-	4.794^{cd}	2.717^{ab}	4.932^{a}	-	-	7.650^{a}	6.222^{b}
A_3B_1		0.473^{g}	0.867^{e}	2.349^{a}	1.034^{b}	4.724^{de}	0.554^{c}	1.515^{f}	1.217^{a}	0.546^{b}	3.483^{f}	4.103^{f}
A_3B_2		0.561^{fg}	1.798^{d}	0.761^{cd}	-	3.119^{g}	0.535^{c}	4.064^{bc}	1.037^{a}	-	5.634^{d}	4.377^{e}
A_3B_3		1.077^{de}	3.983^{a}	-	-	5.058^{c}	0.583^{c}	4.676^{ab}	-	-	5.260^{d}	5.159^{d}

Means designated by the name letter(s) are not significantly different at the 0.05 level according to Duncan's multiple range test.

Table (3): Chemical constituents on dry matter basis (%) of forage crops at different cuts in 998 season.

Treatment		CP (%)					CF (%)					Ash (%)				
		1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean
Forage crops	**(A):**															
Forage sorghum	(A_1)	13.7	11.1	12.4	14.3	12.88	35.6	34.0	32.9	30.2	33.18	13.8	13.3	11.4	10.9	12.35
Pearl millet	(A_2)	16.4	9.8	10.1	9.7	11.50	33.9	34.0	32.2	33.8	33.48	13.4	11.4	11.9	10.7	11.85
Teosinte	(A_3)	17.4	11.0	12.3	13.8	13.63	30.1	31.3	31.5	30.0	30.73	12.0	11.4	11.5	11.8	11.68
Number of cuts	**(B):**															
Four cuts	(B_1)	17.9	11.3	12.2	12.6	13.50	31.5	32.1	31.1	31.3	31.50	14.4	13.0	12.3	11.1	12.70
Three cuts	(B_2)	15.8	11.1	11.0	-	12.63	33.3	32.3	33.2	-	32.93	12.9	12.3	10.9	-	12.03
Two cuts	(B_3)	13.8	9.5	-	-	11.65	34.8	34.9	-	-	34.85	11.9	10.8	-	-	11.35

Table (4): Some agronomic characters of forage crops at different cuts in 1998 and 1999 seasons.

Treatment		Plant height (cm)				Stem diameter (cm)				Fresh leaf/stem ratio (%)				Dry leaf/stem ratio (%)			
		Cut_1	Cut_2	Cut_3	Cut_4	Cut_1	Cut_2	Cut_3	Cut_4	Cut_1	Cut_2	Cut_3	Cut_4	Cut_1	Cut_2	Cut_3	Cut_4
1998 Forage crops (A):																	
Forage sorghum	(A_1)	134.2^a	148.9^a	124.3^a	159.5^a	1.10^a	1.06^a	0.95^a	0.90^a	39.5^c	38.1^c	41.2^b	35.3^a	69.9^c	74.0^c	55.1^b	45.6^a
Pearl millet	(A_2)	66.7^b	128.1^b	120.5^{ab}	134.8^a	0.96^b	1.03^a	0.75^b	0.75^b	156.6^b	61.0^b	33.4^c	23.1^c	211.3^b	94.3^b	50.8^c	31.4^b
Teosinte	(A_3)	57.7^b	93.8^c	99.1^b	131.3^a	0.91^b	0.91^b	0.55^c	0.63^c	187.4^a	66.0^a	50.2^a	29.4^b	263.5^a	113.2^a	82.3^a	34.6^b
Number of cuts (B):																	
Four cuts	(B_1)	48.6^c	79.6^c	87.2^b	141.8	0.95^b	0.91^b	0.75^a	0.67	148.7^a	74.5^a	42.6^a	29.3	233.7^a	145.2^a	62.6^a	37.3
Three cuts	(B_2)	81.2^b	124.6^b	141.9^a	-	0.89^b	0.81^c	0.74^a	-	131.5^b	59.2^b	40.5^a	-	195.6^b	95.9^b	62.9^a	-
Two cuts	(B_3)	128.8^a	166.5^a	-	-	1.14^a	1.27^a	-	-	103.3^c	31.2^c	-	-	115.5^c	40.4^c	-	-
1999Forage sorghum (A):																	
Forage sorghum	(A_1)	135.5^a	200.9^a	103.7^a	106.0^a	1.34^a	1.45^a	1.31^a	1.38^a								
Pearl millet	(A_2)	68.7^b	179.3^b	101.8^a	101.3^a	0.96^b	1.39^b	1.07^b	1.13^{ab}								
Teosinte	(A_3)	34.3^c	123.3^c	83.8^b	74.0^b	0.83^c	1.31^c	1.00^b	1.05^b								
Number of cuts (B):																	
Four cuts	(B_1)	63.0^b	129.0^c	60.2^b	93.8	0.92^b	1.37^b	1.02^b	1.19								
Three cuts	(B_2)	84.2^a	149.9^b	132.5^a	-	0.97^b	1.31^b	1.24^a	-								
Two cuts	(B_3)	91.0^a	224.7^a	-	-	1.24^a	1.46^a	-	-								

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