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Effects of Cutting height on the harvest times and forage yield of new sorghum cultivars in sistan region

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ABSTRACT: Sorghum (Sorghum bicolor) is a warm-season annual grass with great ability to produce high forage biomass yields. It can be used for the production of energy, fibre or paper, as well as for syrup and animal feed. Sorghum is a highly drought-tolerant field crop. Identification of cutting intervals and cutting heights that optimize the net forage accumulation and delay senescence and stem accumulation would favor the efficient accumulation of large quantities of highly nutritious forage. The field experiment was laid out split plot with randomized complete block design with four replications. Treatments included cutting height (b1= 0, b2=5, b3=10, b4=15) and variety (feed speed, pegah, indian). Analysis of variance showed that the effect of variety and cutting height on all characteristics in was significant.

Key words: Plant height, wet forage, dry forage

INTRODUCTION

Sorghum (Sorghum bicolor) is an important alternative for human and animal food, especially in regions of low water availability, in which seed is rich in protein, vitamins, carbohydrates and minerals. Also, the plants have a high green mass and are tolerant to drought (water stress) and high temperatures (Carvalho *et al.* 2000). Sorghum (Sorghum bicolor) is a warm-season annual grass with great ability to produce high forage biomass yields (Fribourg 1995; Rooney *et al.* 2007). It can be used for the production of energy, fibre or paper, as well as for syrup and animal feed (Steduto *et al.* 1997). Sorghum is a highly drought-tolerant field crop. It has low water requirements, and therefore it is widely used as a fodder crop in many regions of the world. However, as with other crops, high yield can be achieved only through the use of suitable agronomic practices (ICRISAT/FAO 1996; Zerbini and Thomas 2003). In order to expand the use of sorghum as a forage crop, its tendency to lodging, a characteristic of the tall forage sorghum types, must be overcome (Miron *et al.* 2005). Another obstacle to the expanded use of tall forage sorghum is its insufficient accumulation of dry matter content (Miron *et al.* 2006). Today there are different cultivars of sorghum that are grown for various purposes, either for animal feed production or for human nutrition, especially cultivars whose seeds have a high nutritional value and contain few harmful substances. These plant species have special importance in the agricultural production of developing countries (Taylor 2004

Sorghum has an important role in the production of ethanol and other bio industrial products such as bio plastics (McLaren *et al.* 2003). The biomass of fodder sorghum, Sudan grass, and their hybrid is usually used fresh or for preparation of silage, while it is rarely used for the preparation of hay or grazing (Eric *et al.* 1999). Depending on use of the biomass (hay, silage, or fresh), suitable agronomic practices are applied. If these plants are grown for fresh biomass or for grazing, sowing is denser, with higher consumption of seed per hectare, while for silage production, plants are grown on a larger vegetation area (Kruzin and Casovskih 1997). Current recommendations regarding cutting height of alfalfa are designed to maximize yield while maintaining high quality forages and stand longevity. Forage growers frequently cut forages at a height of three or more inches. However, recent reports indicate that there may be an advantage to cutting alfalfa closer, leaving an inch or less of stubble height (agriculture Online, 1999). Research indicates that dry matter yields and nutrient yields are higher for shorter cutting heights as compared to leaving taller stubble (Sheaffer et al., 1988). Obtaining higher yields requires that the plants are healthy and that carbohydrate root reserves are adequate for plant regrowth following harvest. Early Wisconsin studies using Vernal alfalfa showed that forages harvested three or four times per season produced more total forage when cut at a 1-inch height versus cutting at 3 inches or more (Kust and Smith, 1961, Smith and Nelson, 1967). North Dakota research looking at cutting height since the mid-1960s shows similar results where shorter cutting height leads to higher yields.

Cutting height can be used to manipulate whether stems originate from crown or stem buds. Low cutting height stimulates crown bud development and high cutting height stimulates stem bud development. Crown buds are more productive than stem buds, so stimulation of crown bud development by lower cutting heights (i.e. 2 to 3 inches) is usually desirable. However, raising cutting height may be desirable 1) if crown bud development is suppressed by frequent or early cutting, 2) to avoid cutting crown re-growth buds if the alfalfa is cut late, or 3) possibly during the summer when crown bud development is low (Kust and Smith, 1961). Identification of cutting intervals and cutting heights that optimize the net forage accumulation and delay senescence and stem accumulation would favour the efficient accumulation of large quantities of highly nutritious forage (Pinto *et al.* 2001; Carnevalli *et al.* 2006; Barbosa *et al.* 2007; Difante *et al.* 2009; Da Silva *et al.* 2009).

MATERIAL AND METHODS

The experiment was conducted at the Zabol which is situated between 31° North latitude and 61° East longitude. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics. The field experiment was laid out split plot with randomized complete block design with four replications. Treatments included cutting height (b1 = 0, b2=5, b3=10, b4=15) and variety (feed speed, pegah, indian). Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

RESULTS AND DISCUSSION

A. Plant height

Analysis of variance showed that the effect of variety on Plant height in was significant (Table 1). The maximum of Plant height in cutting 1 of treatments feed speed was obtained (Table 2). The minimum of Plant height in cutting 1 of treatments indian was obtained (Table 2). The maximum of Plant height in cutting 2 of treatments feed speed was obtained (Table 2). The minimum of Plant height in cutting 2 of treatments indian was obtained (Table 2).

Table 1: Anova analysis of the sorghum affected by cutting height and variety.

S.O.V	f	Height (b1)	Height (b2)	Height (b3)	Wet forage(b1)	Wet forage(b2)	Wet forage(b3)	dry forage(b1)	dry forage(b2)	dry forage(b3)
R		263.6 ^{ns}	787.35 ^{ns}	361.83 ^{ns}	7.76 ns	124.47 ns	27.63 ns	0.06$^{n.s}$	0.05 ^{ns}	0.05 ^{ns}
a		12614.8**	6956.77**	21451.79**	222.50 **	998.91 **	551.48 **	1.26**	1.62**	4.96**
R*a		214.75$^{n.s}$	360.85 ^{ns}	203.45 ^{ns}	12.45n.s	62.52 ns	27.04 ns	0.07$^{n.s}$	0.09$^{n.s}$	0.13$^{n.s}$
b		607.85*	7047.46**	17353.83**	155.78*	686.76 *	247.32 **	2.25**	3.24**	3.43**
a*b		1717.06**	638.88*	1016.79**	94.06n.s	200.27 *	63.30 *	0.22*	0.33*	0.94**
Error		474.10	242.00	94.98	51.10	79.84	25.48	0.07	0.12	0.09
CV (%)		11.42	7.86	6.46	9.73	8.66	8.95	11.51	9.77	14.94

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.

The maximum of Plant height in cutting 3 of treatments feed speed was obtained (Table 2). The minimum of Plant height in cutting 3 of treatments indian was obtained (Table 2). Analysis of variance showed that the effect of cutting height on Plant height was significant (Table 1). The maximum of Plant height in cutting 1 of treatments control (no cutting height) was obtained (Table 2). The minimum of Plant height in cutting 1 of treatments 15 cm was obtained (Table 2). The maximum of Plant height in cutting 2 of treatments 15 cm was obtained (Table 2). The minimum of Plant height in cutting 2 of treatments control was obtained (Table 2). The maximum of Plant height in cutting 3 of treatments 15 cm was obtained (Table 2). The minimum of Plant height in cutting 3 of treatments control was obtained (Table 2).

Table 2: Comparison of plant height affected by variety and cutting height.

Treatment	Plant height (cutting 1)	Plant height (cutting 2)	Plant height (cutting 3)
Variety			
Feed speed	216.87a	221.3a	178.5a
Pegah	193.81b	190.3b	146.1b
Indian	161c	181.6b	127.3c
Cutting height (cm)			
0	219.3a	146.6c	116.5d
5	198.2b	196.2b	146.1c
10	197.8b	209.4a	159.1b
15	146.8c	220.7a	180.9a

Any two means not sharing a common letter differ significantly from each other at 5% probability

B. Wet forage yield

Analysis of variance showed that the effect of variety on wet forage yield in cutting 1 was not significant (Table 1). Analysis of variance showed that the effect of variety on wet forage yield in cutting 2 and cutting 3 was significant (Table 1). The maximum of wet forage yield in cutting 2 of treatments feed speed was obtained (Table 3). The minimum of wet forage yield in cutting 2 of treatments Indian was obtained (Table 3). The maximum of wet forage yield in cutting 3 of treatments feed speed was obtained (Table 3). The minimum of wet forage yield in cutting 3 of treatments indian was obtained (Table 3). Analysis of variance showed that the effect of cutting height on wet forage yield in cutting 1 was significant (Table 1). The maximum of wet forage yield in cutting 2 of treatments 15 cm was obtained (Table 3). The minimum of wet forage yield in cutting 2 of treatments control was obtained (Table 3). The maximum of wet forage yield in cutting 3 of treatments 15 cm was obtained (Table 3). The minimum of wet forage yield in cutting 3 of treatments control was obtained (Table 3).

Table 3: Comparison of wet forage yield affected by variety and cutting height.

Treatment	wet forage yield (cutting 2)	wet forage yield (cutting 3)
Variety		
Feed speed	190.39a	60.56a
Pegah	105.77a	58.93a
Indian	94.26b	49.68b
Cutting height (cm)		
0	92.58b	52.67b
5	103.64a	52.72b
10	106a	58.18a
15	110.33a	61.98a

Any two means not sharing a common letter differ significantly from each other at 5% probability

C. Dry forage yield

Analysis of variance showed that the effect of variety on dry forage yield was significant (Table 1). The maximum of dry forage yield in cutting 1 of treatments feed speed was obtained (Table 2). The minimum of dry forage yield in cutting 1 of treatments indian was obtained (Table 2). The maximum of dry forage yield in cutting 2 of treatments feed speed was obtained (Table 4). The minimum of dry forage yield in cutting 2 of treatments indian was obtained (Table 4). The maximum of dry forage yield in cutting 3 of treatments feed speed was obtained (Table 4). The minimum of dry forage yield in cutting 3 of treatments indian was obtained (Table 4). Analysis of variance showed that the effect of cutting height on dry forage yield in cutting 1 was significant (Table 1). The maximum of dry forage yield in cutting 2 of treatments 15 cm was obtained (Table 4). The minimum of dry forage yield in cutting 2 of treatments control was obtained (Table 4). The maximum of dry forage yield in cutting 3 of treatments 15 cm was obtained (Table 4). The minimum of dry forage yield in cutting 3 of treatments control was obtained (Table 4).

Table 4: Comparison of plant height affected by variety and cutting height.

Treatment	Dry forage yield (cutting 1)	Dry forage yield (cutting 2)	Dry forage yield (cutting 3)
Variety			
Feed Speed	2.71a	3.99a	2.57a
Pegah	2.39b	3.67b	2.09b
Indian	2.15c	3.35c	1.45c
Cutting height (cm)			
0	2.91a	3.16c	1.49c
5	2.56b	3.33c	1.73c
10	2.33b	3.9b	2.24b
15	1.88c	4.29a	2.69a

Any two means not sharing a common letter differ significantly from each other at 5% probability

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