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Effect of Stage of Cutting Alfalfa (Berseem) on Crude Protein Content and Dry Matter Yield

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ABSTRACT

This study focuses on factors affecting cutting of berseem (Medicago sativa L.) and the effect of the stage of cutting on crude protein content and on dry matter yield. The study was conducted in Khartoum North (EL Selate project). On afarmer was field. The major problem there is growing demand from the Gulf States for alfalfa (Medicago sativa L.) with high crude protein content reaching up to 23%. Although alfalfa with this amount of crude protein may fetch relatively high price yet it can be obtained only if the crop is cut at an early stage of maturity which reflects negatively on total dry matter production and on total crude protein produced per unit area .It is therefore important to find the optimum stage of growth for cutting alfalfa that meets the export quality requirements without seriously jeopardizing the total dry matter and crude protein production thus assuring maximum net returns per unit area of land. The main objective of this study is to investigate the some factors that affect cutting of alfalfa and the stage of cutting on crude protein content and on dry matter yield. The treatments in this study include alfalfa (Hegazi berseem) which is commercially grown in the Sudan. An area of 2.1hectar was allocated for the experiment on condition that samples will be taken at specific intervals after the farmer cuts his plot. Samples were obtained first at 7 days after harvest and thereafter at 3 day intervals until the farmer gets his next harvest which occurs usually between 21 and 30 days after the first harvest. A plot of size 6x5 m^2 was randomly selected from each feddan. Three samples were cut from each plot using a quadrate 0.5x0.5 m^2 and weighed in the field and after dried in an oven at a temperature of 65 degree Celsius drying to determine dry matter production. The results indicated that there is no justification to harvest alfalfa at an age of 10-13days to obtain 23% of CP as this leads to a loss of 64% in dry matter or (816kg/ha), while harvesting at 30 days gives 17.5% CP. The latter figure is within the range of CP requirement in the diets of dairy cattle (14-19%).

Keywords: *Medicago sativa L, stage of cutting, crude protein, berseem, alfalfa,*

1. INTRODUCTION

The study was carried out in Khartoum State, Sudan which lies in the semi-arid savannah belt of the Sudan (ELSiddig et al., 2010). It has an area of 21,000 km^2. It falls between latitudes 15° 10 –16° 30′ N and 31° 40′–34° 20′E in the central part of Sudan (El-Khalifa et al., 2008). Annual rainfall is 155 mm occurring mainly in July and August. Annual maximum temperature is 38°C (Wikipedia, 2010). Irrigated forages in the Sudan constitute about 4% of the total natural pasture and silvo pastoral grazing (Ahmed and Sid Ahmed, 2009). In the Sudan alfalfa was first introduced during the world war1 when seed the verity hegazi was imported from Egypt for cultivation in Khartoum north (Agabawi, 1968). The crop grows and produces best on well drained fertile soils with good moisture holding capacity the crop grow in clay soils but care needs to be taken to avoid standing water and conditions that create water logging to which the crop is very sensitive .It can also grow on sandy soils Small holders plough the land, irrigate to loosen the soil and then break clods using a spade or hoe. Some use a tractor with a harrow to carry out this operation. Emerging weeds are then removed. This is followed by dividing the area into small basins and opening irrigation canals. Each basin is carefully leveled and the seed-bed smoothened in preparation for planting (Zaroug, 2005). There are conflicting reports about optimum seed rate for alfalfa and a range from 12 kg/ha to 47.6 kg/ha has been reported. Farmers use 20-50kg/ha and 53-106 kg/ha depending on method of planting, seed price, type of soil and degree of infestation (Khair, 1997). The first irrigation should be gentle to avoid washing away the sown seed. Alfalfa is known for its high water consumption. Several studies indicated that frequent irrigation is favorable for growth and forage production. Traditionally the crop is irrigated every 7 and 10 days during the summer and cool season. Respectively (Zaroug, 2005). Saeed et al. (1983) reported that the best fodder yield of Lucerne and highest water use efficiency can be obtained by irrigating at a rate of 7 mm per day and an interval of 7 days compared to intervals of 10 days or longer with the same daily rate of water application (7 mm per day). The first cut after establishment is obtained about two months from planting and is characterized by low yield and dry matter content .Subsequent cuts are obtained every 21 to30 days. Harvesting is done at 10-50% flowering depending on market condition. Plants are cut 5-8cm above ground level. Manual harvesting using a sickle is common among small holders but some of the large producers may also apply mechanical harvesting. Dry matter yield estimates are 0.9-1.2 ton/ha/cut (Zaroug, 2005).

The total area under alfalfa in Sudan is about 125,000faddans, the annual production is estimated to be about 1,062,500 tons / year green forage (Abu suwar, 2004).

Khartoum State land currently under agriculture accounts for 80,000 ha. The main crops grown are horticultural and forage crops. The two main forage crops grown are Sorghum forage (Abu Sabeen) and alfalfa

(Medicago sitiva) or Berseem as it is referred to locally. Both crops are grown under irrigation by pumps from the River Nile or from the Blue and White Niles. Recently alfalfa is increasingly being exported to the Gulf States who insist on crude protein content in alfalfa of about 23%. Production of alfalfa with such specifications must occur at the expense of dry matter yield. This research is initiated to assess the of DM yield and total CP produced per ha when alfalfa is cut in an early stage of growth to obtain the required high CP.

2. RESEARCH OBJECTIVES

The main objective of this study was to investigate the effect of stage of cutting of alfalfa on crude protein content and on dry matter yield.

3. MATERIALS AND METHODS

3.1 Treatments and Experimental Design

An arrangement was made with a farmer who agreed to allocate an area of 2.1 hectares of alfalfa for the experiment on condition that samples will be taken at specific intervals after he cuts his plot. Samples were obtained first at 7 days after harvest and thereafter at 3 day intervals until the farmer gets his next harvest which occurs usually between 21 and 30 days after the first harvest. A plot of 6x5 m^2 area was randomly selected from each (0.42 ha). Three samples were cut from each plot using a quadrat 0.5x0.5 m^2. Samples were weighed in the field and then dried in an oven at 65 ^oC to determine dry matter yield.

3.2 Forage Yield

The whole plot was cut and the green weight was determined immediately using a sensitive balance and green forage yield per hectare was calculated. Dry matter yield was assessed from samples taken from an area of 0.5m^2 from each plot, oven dried at a temperature of 65 ^oC to determine the dry weight. Dry forage yield was then calculated.

3.3 Crude Protein

A subsample from each cut was analyzed for crude protein content using Kjeldahl procedure (AOAC, 1980). The data was used to calculate crude protein percent as well as dry matter and total crude protein per ha.

4. RESULTS AND DISCUSSION

4.1 Productivity of Alfalfa

Results showing productivity of alfalfa are given in Table1. Dry matter yield from a single cut at 30 days of age was 1,287 kg/ha . This amounts to 15,444 kg /ha/ year assuming 12 cuts/ year. The data of Khartoum State Ministry of Agriculture, Animal Resources and Irrigation gave yields of 15.7 t/ha/year during 2007(Dia Eddin, personal communication). In terms of green matter the present experiment resulted in 5,531 kg/ cut /ha when alfalfa was cut at 30 days of age**.** Abusuwar and Ahmed (2003) obtained dry matter yields of 1.9 tons/ha. Fadul (2001) obtained green forage yield of 9.8 tons/cut/ha; while Nayel and Khider (1995) found DM yields of 1.98-2.53 tons /ha. Khair (1999) reported mean DM yields of 17.9 t/ha/year. The relatively lower yields in this experiment may be due to the fact that the 30 day cut in this study was taken in October while the results obtained by these authors are the mean of one complete year which included a number of cool months that are more favorable for alfalfa growth.

Table 1: Mean yield of green and dry matter alfalfa cut at different stages of growth after harvest

Age of plant (day)	Green forage yield (kg/ha)	DM forage yield (kg/ha)
7	787	140
10	1626	361
13	1843	463
17	2620	649
21	3708	832
24	4444	959
27	5005	1136
30	5531	1287

4.2 Chemical Composition of Alfalfa

4.2.1 Crude Protein

Dry matter forage yield (kg/ha), crude protein (%) and total crude protein (kg/ha) of alfalfa at different stages of growth post cutting are given in Table2. Dry matter yield was calculated from the regression equation below which was developed from the experimental data:

$Y=48x-165.86$

Where, Y= DM Yield (kg/ha), X= age of plant post cutting.

It appears from the table that harvesting alfalfa to obtain a crude protein percent of 23% it has to be cut at the age of 10-13 days after previous cut. This means a loss in dry matter yields of 816 kg/cut /ha or 64% of the dry matter yield obtained when the crop was harvested at 30 days post-cutting. Harvesting at 10-13 days resulted in forage of 22-24% CP while harvesting at 30 days gives 17.5% CP. The latter figure is within the range of CP% requirement in the diets of dairy cattle (14-19%) (NRC, 2001). So there is no justification for harvesting at this stage of growth as the losses in dry matter are large and the benefits in terms of increase in % CP are negligible.

Table 2: Mean DM yield and crude protein content of alfalfa cut at different stages of growth

Age of plant/day	Mean dry matter yield/(kg/ha)	Protein (%)	Total CP(kg/ha)
7	170	26.0	44.2
10	314	24.0	75.4
13	458	22.0	100.8
17	650	21.0	136.5
21	842	19.3	162.5
24	936	18.6	179.1
27	1130	17.5	197.8
30	1274	17.5	223.0

5. CONCLUSION

Dry matter forage yield from a single cut of alfalfa at 30 days of age was approximately 1..3 tons/cut/ha or 15.6 tons /ha/ year assuming 12 cuts/ year. In terms of green matter this experiment resulted in 5.5 tons / cut/ ha when alfalfa was cut at 30 days of age. Since CP% at 30 days of age was 17.5% it seems that there is no justification to harvest alfalfa at an age of 10-13 days to obtain 21-23% of CP protein as this resulted in a DM loss of 64% compared with harvesting at 30 days. Moreover the CP of 17.5% obtained at the age of 30 days is within the range of CP requirement in the diets of dairy cattle (14-19%).

6. RECOMMENDATIONS

In order to improve berseem production it is recommended that Berseem must be cut at an age that allows for maximum DM forage production while at the same time giving a reasonable content of CP; this usually occurs at 27-30 days of age.

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