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Effect of different clipping times on forage quality of three cereal crops at two locations of sulaimani region

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Abstract

The present study was conducted in Sulaimani Region at two different locations, Qlyasan and Kanipanka during the winter season of 2010-2011, to determine the effect of different clipping times{clipping at 80 days after sowing (1^{st} clipping time), clipping at 90 days after sowing (2^{nd}clipping time), clipping at 100 days after sowing (3^{d}clipping time), and clipping at 110 days after sowing (4^{th} clipping time) as well as control (no clipping)}on forage quality of three cereal crops (wheat, barley and triticale) at Qlyasan location and the following day similarity at Kanipanka location. The design was split plot within factorial experiment, the cereal crops were implemented in the main plots and arranged with complete randomized design (CRBD) and replicated three times, where the clipping times were implemented in sub plots. Means comparison were carried out using least significant difference test (LSD) at 0.05 significant levels.

The results of the present study as the average of both locations showed that the fourth clipping time exceeded the other clipping times in the characters: Acid Detergent Fiber (ADF%), Acid Detergent Lignin (ADL%), Neutral Detergent Fiber (NDF%), fiber%, starch% and Mg% with the values of 28.222%, 5.645%, 39.194% , 14.282%, 8.223% and 0.080% respectively, while the first clipping time exhibited maximum values of 14.561% , 24.992%, 81.138%, 0.545% , 4.408%, 0.583% and 3.734% for the characters Ash%, protein%, DP%, Ca%, K%, P% and fat% respectively.

According to the results of this study we concluded that protein and digestible protein were differed significantly among species, where barley showed its superiority in these characters and most quality traits compared to wheat and triticale, and The quality was diminished as maturity increased, the nutrient composition and forage quality of small grain plants change significantly as the plants develop; therefore, the earlier cutting dates are recommended to achieve this purpose.

Introduction

Forage quality is defined as the sum total of the plant constituents that influence an animal's use of the feed. Factors which determined forage quality include the following: Palatability, Digestibility, Nutritive content, Anti nutrient factors and animal performance **(1)**. Annual forages can be used for many purposes in cropping and livestock systems. This article focuses on forage yield and quality of unconventional annual forages and their potential for extending the livestock grazing season. Winter cereals offer good yields and good quality forage options for livestock grazing **(2).** These crops are a source of high quality forage that can easily be used for pasture.Winter cereals can be used to maintain the pasture base while perennial pasture is being rejuvenated or reseeded. The quality of the crop for forage in the autumn allows producers to maintain cattle gains as perennial pastures become unproductive and deteriorate in quality **(3).**

A number of cereals grown for forage, for example maize and wheat, have become of increased importance in the rations of ruminants animals **(4).** These types of cereal-based forages have the potential to supply large amount of energy for animals. Livestock nutritional resources are pastures, meal and forage crops. Although concentrates have been used in the dairy cattle rations, forage crops perform an important role in energy and protein supply for livestock. Unfortunately, cereals often contain low protein and, thus, low forage quality. In recent years, advances in plant and animal breeding, introduction of new products and development of new management approaches have made it possible to increase animal performance. However, for this to be realized there must be additional focus on forage quality **(5).**With winter types, by deferring early grazing, more feed can be accumulated and saved for winter. For erect types, crops will usually be 20–25 cm high, and for prostrate types 10–15 cm high. Residual plant heights of around 5–10 cm for prostrate types and 10–20 cm for upright types **(6).** Cutting height is usually conducted at 7–10 cm above ground level. Cutting higher will result in a slight increase in nutritive value but will also reduce yields accordingly. A higher cutting height will also be reduced the risk of soil contamination from other equipment operations such as raking. Cutting at greater heights will leave behind increased levels of stubble which creates a problem in removing and preparation for the next forage in future **(7).** An understanding of factors affecting forage quality will help producers expect and changing program in forage quality. Six major factors affecting forage quality, ranked by their impact on forage quality included: Maturity (harvest date), Crop species, Harvest and storage, Environment, Soil fertility and variety (cultivar) that was ranked by their effect on forage quality **(1).**For forage crops, it is important to producing greater forage yields per hectare, higher nutritional quality (percentage composition of selected nutrients) or combined nutrient yields. High forage yield is very important for producers but for livestock Enterprises, it is also important to produce high quality forages **(8).** Profitable livestock production is based on good forage management. Forage yield and quality have major impacts on the economics of harvesting stored feed. When the first cut is delayed, forage yield will also increase, but forage quality and aftermath yield decrease. If forage quality is too low, some of livestock may need an energy or protein supplement to meet their nutritional needs. Because different classes of livestock have different nutrient requirements, the optimal cutting date will depend on the needs of livestock to eat the hay **(9).**

The objective of present study was to determine the effect of different clipping times on forage quality of three cereal cropsat two locations of sulaimani region.

Materials and Methods

Factorial experiment was conducted at two different locations. The first was at Qlyasan Agricultural Research Station, Faculty of Agricultural Sciences-University of Sulaimani located (Lat 35˚ 34′ 307″; N, Long 45˚ 21′ 992″; E, 765 masl[2]) two Km North West of Sulaimani City, the second was at Kanipanka Nursery Station (Lat 35˚ 22′; N, Long 45˚ 43′; E, 550 masl[2]) in Shahrazoor valley 35 Km East of Sulaimani city during the winter season of 2010-2011, to study theeffect of different clipping times on forage quality of three cereal crops at two locations conducted in split plot design.

[2] : Meter Above Sea Level.

Three cereal crops were implemented in the main plots and arranged according to CRBD and replicated three times. The cutting treatments allotted in sub plots which consisted of {no cut (control), cut at 80 days after sowing (cut1), cut at 90 days after sowing (cut2), cut at 100 days after sowing (cut3), and cut at 110 days after sowing (cut4)}, were dated March 8th, 18th, 28th, and April 7th for cutting treatments at Qlyasan location respectively, While at Kanipanka location they were dated March 9th, 19th, 29th, and April 8th respectively. Each sub plots consist of 10 rows, four meter long with 0.25m apart rows.Sowing was conducted during Dec.18th and Dec.19th of 2010 at Qlyasan and Kanipanka location respectively according to the recommended seed rates (200Kg/ha) for all crops used and the recommended dose of fertilizer was used (80 kg N/ha and 80 kg P_2O_5/ha). All required agricultural practices were used as needed.

The experiment were harvested for grain yield according to the full maturity on June 14, 2011 for barley, and June 17, 2011 for wheat and triticale at Qlyasan location, while at Kanipanka location all the crops were harvested on June 23, 2011.

A. Studied characters:

Forage quality parameters for varieties and different clipping times: The following quality parameters were determined by (Reflection Infrared Spectroscopy FT-IR Techniques) for all clipping samples after drying and grinding:

Protein%, Digestible Protein%, Ash%, Starch%, Fat%, Acid Detergent Fiber (ADF %), Acid Detergent Lignin (ADL %)**,** Neutral Detergent Fiber (NDF %)**,** Fiber%, Lignin%, Calcium %, Magnesium%, Potassium%**,** and Phosphor%

B. Chemical analysis:

Analysis of the results was carried out with the "technique Powered by "Reflection Infrared Spectroscopy FT-IR Techniques" as an important technique in chemistry. Calibration and accuracy were conducted according to scans and analysis ran by Mr. Justen Smith who is specialist in livestock and Feed Specialist USAID, Agribusiness Project {Al Hashimi group CO. (International Technical Lab.)} in Baghdad.

C. Statistical analysis:

The data were statistically analyzed according to the methods of analysis of variance as a general test, and combined analysis of variance across locations was also conducted **(10).**

Results and Discussion

Effect of clipping times on forage quality characters:

A. Protein percent

Highly significant differences were occurred among clipping times for the component of protein% at both locations and their average (Table 1). The highest protein content produced by the treatment of first clipping time with 26.919, 23.066 and 24.992% at both locations and their average respectively. Whereas the lowest protein% was recorded by the treatment of fourth clipping time with 17.945, 13.806 and 15.876% at both locations and their average respectively.

Similar results were obtained by **(Ayup, *etal* 1999)** whom reported that crude protein% in the whole barley plant was decreased with time and remained constant near maturity, while **Weichenthal, *etal* 2001** reported that forage quality results showed a variation in CP, which often was due to maturity differences when harvested.

B. Digestible Protein percent (DP %)

Data represented in (Table 1) confirmed the presence of highly significant differences among clipping times due to the component of DP% at both locations and their average. Maximum available digestible protein was exhibited by the treatment of first clipping time at both locations and their average (83.812, 78.464 and 81.138%) respectively, in which the minimum DP% was recorded by the treatment of fourth clipping time with 72.979, 67.106 and 70.042% at both locations and their average. respectively.

C. Ash percent

Results of (Table1) revealed that the component of Ash% responded was highly significant to different clipping times at both locations and their average. First clipping time gave the highest values of Ash% with 15.443, 13.678 and 14.561% at both locations and their average respectively. While the lowest values of Ash% was recorded by the treatment of fourth clipping time with 9.869 and 9.747% at Qlyasan location and the average of both locations respectively. However at Kanipanka location, the third clipping time was recorded with the minimum value of Ash% (9.524%). Previous results showed that harvest treatments and varieties were significantly affected the value of crude Ash content **(13),** and **(Collar, *etal*. 2004)** reported that there were small differences between the grain types in quality parameters including Ash content which were the highest at booting stage and decreased for all cereal cultivars when they matured.

D. Starch percent

The differences among clipping times were highly significant as shown in (Table1) for the component of starch% at both locations and their average. The treatment of fourth clipping time was exceeded the other recordings 7.917, 8.529 and 8.223% at both locations and their average respectively, while the first clipping time recorded minimum starch% at both locations and their average with 3.898, 4.704 and 4.301% respectively.

Similar results exhibited by **(Collar, *etal.* 2004)** showed that as the plant matures, grain development contributes non-fibrous (or non-structural) carbohydrate (starch) that dilutes the fiber component.

E. Fat percent

Highly significant differences were observed among clipping times in (Table1) due to the component of fat% at both locations and their average. The highest value of fat% exhibited by the treatment of first clipping time at both locations and their average were 4.173, 3.295 and 3.734% respectively. Whereas the lowest fat% was recorded by the treatment of fourth clipping time(2.700, 1.665 and 2.183%) at both locations and their average respectively.

Previously it was noticed that the value of crude Fat content (CF) was affected by harvest and varieties treatments significantly. Meanwhile, there were significant interaction effects between harvest treatments and varieties on this quality parameter **(13).**In general, the high quality parameters of (Protein, DP, Ash and Fat %) at the early growth stage may be due to higher leaf/stem ratio, in which the leaves contain more protein and low fiber.

Table-1: Effect of clipping times on forage quality characters at both locations and their average.

Clipping times	***Protein%***	***DP%***	***Ash%***	***Starch%***	***Fat%***
			Qlyasan		
1	*26.919*	*83.812*	*15.443*	*3.898*	*4.173*
2	*24.040*	*79.121*	*12.267*	*4.791*	*3.913*
3	*19.450*	*76.693*	*10.593*	*7.726*	*3.066*
4	*17.945*	*72.979*	*9.869*	*7.917*	*2.700*
LSD$_{(P<0.05)}$	*0.858*	*0.793*	*0.421*	*0.727*	*0.160*
			Kanipanka		
1	*23.066*	*78.464*	*13.678*	*4.704*	*3.295*
2	*18.158*	*76.293*	*10.633*	*5.953*	*3.139*
3	*15.862*	*72.316*	*9.524*	*7.674*	*1.995*
4	*13.806*	*67.106*	*9.625*	*8.529*	*1.665*
LSD$_{(P<0.05)}$	*0.739*	*1.114*	*0.398*	*0.578*	*0.177*
			Average of both locations		

1	*24.992*	*81.138*	*14.561*	*4.301*	*3.734*
2	*21.099*	*77.707*	*11.450*	*5.372*	*3.526*
3	*17.656*	*74.504*	*10.059*	*7.700*	*2.530*
4	*15.876*	*70.042*	*9.747*	*8.223*	*2.183*
$LSD_{(P<0.05)}$	*0.560*	*0.676*	*0.286*	*0.459*	*0.118*

F. Fiber percent

Results of (Table 2) revealed that there were highly significant differences among clipping times for the component of fiber% at both locations and their average. Maximum fiber% was obtained by the treatment of fourth clipping time with 12.474, 16.090 and 14.282% at both locations and their average respectively. In which minimum fiber% were exhibited by the treatment of first clipping time at both locations and their average with 2.072, 5.188 and 3.630% respectively.

Similar results were reported by **(Fohner, 2006)** reflecting the decline in protein percent and fiber digestibility and an increase in starch that occur as the plant matures **(14).**

Previously it is confirmed that the fiber level was usually lower or about the same at soft dough as it is at booting stage, due to the development of the grain **(15)**.

G. Lignin percent

Data in (Table 2) indicates the presence of highly significant differences among clipping times due to the component of Lignin% at both locations and their average. Maximum lignin contents were obtained by the treatment of second clipping time at Qlyasan location and the average of both locations with 2.491 and 1.956% respectively. While at Kanipanka location, the treatment of first clipping time gave the maximum lignin percent of 1.990%. Minimum value of lignin% was exhibited by the treatment of third clipping time at Kanipanka location and the average of both locations with 1.317 and 1.401% respectively. In which the first clipping time gave minimum value of lignin% with 1.333% at Qlyasan location. Previous workers estimated that lignin was the highest at flowering stage for all cereal cultivars, while others indicated that the highest lignin content was at the milk stage **(14),** and **(12)** reported that the reduced lignin fiber content of these forages (wheat and triticale) resulted in greater digestibility.

H. Acid Detergent Fiber percent (ADF %)

Data represented in (Table 2) confirmed the presence of highly significant differences among clipping times for the component of ADF% at both locations and their average. The treatment of fourth clipping time gave the highest percent of ADF with 26.680 and 28.222% at Qlyasan location and the average of both locations respectively. While at Kanipanka location the treatment of third clipping time gave the maximum value of 29.834%, however the treatment of first clipping time recorded the lowest percent of ADF with 21.428, 25.382 and 23.405% for both locations and their average respectively.

Similar results were reported by **(16 and 14),** and **(15)** confirmed that the varieties developed for and harvested at the booting stage had higher ADF compared to thosedeveloped for and harvested at the soft dough stage.

I. Acid Detergent Lignin percent (ADL %)

Highly significant differences were observed among clipping times for the component of ADL% at both locations and their average (Table 2). The treatment of fourth clipping time recorded the maximum values of 5.126, 6.164 and 5.645% at both locations and their average respectively. Whereas the first clipping time recorded minimum values of ADL% at Qlyasan location and the average of both locations with 4.296 and 4.611% respectively. At Kanipanka location, minimum ADL% was recorded by the second clipping time with 4.897%.

J. Neutral Detergent Fiber percent (NDF %)

As shown in (Table 2) the differences among clipping times were highly significant for the component of NDF% at both locations and their average. The fourth clipping time exceeded others recording 37.236, 41.151 and 39.194% at both locations and their average respectively, while the treatment of first clipping time recorded minimum NDF% with 28.529, 32.337 and 30.433% at both locations and their average respectively.

Previously it was calculated that the NDF component was the highest at flower stage for all cereal cultivars, but then declined (in some cases dramatically) after significant seed development, or the percentage of fiber did not always increase with increasing maturity **(14).**

Table -2: Effect of clipping times on forage quality characters at both locations and their average.

Clipping times	*Fiber %*	*Lignin %*	*ADF %*	*ADL %*	*NDF %*
			Qlyasan		
1	*2.072*	*1.333*	*21.428*	*4.296*	*28.529*
2	*6.230*	*2.491*	*23.964*	*4.580*	*33.061*
3	*7.676*	*1.486*	*24.810*	*4.443*	*33.382*
4	*12.474*	*1.704*	*26.680*	*5.126*	*37.236*
$LSD_{(P<0.05)}$	*0.876*	*0.228*	*1.093*	*0.236*	*1.059*
			Kanipanka		
1	*5.188*	*1.990*	*25.382*	*4.927*	*32.337*
2	*8.930*	*1.422*	*25.433*	*4.897*	*35.281*
3	*13.537*	*1.317*	*29.834*	*5.699*	*39.536*
4	*16.090*	*1.469*	*29.764*	*6.164*	*41.151*
$LSD_{(P<0.05)}$	*0.794*	*0.283*	*1.214*	*0.240*	*1.435*
			Average of both locations		
1	*3.630*	*1.661*	*23.405*	*4.611*	*30.433*
2	*7.580*	*1.956*	*24.699*	*4.739*	*34.171*
3	*10.607*	*1.401*	*27.322*	*5.071*	*36.459*
4	*14.282*	*1.587*	*28.222*	*5.645*	*39.194*
$LSD_{(P<0.05)}$	*0.584*	*0.179*	*0.807*	*0.166*	*0.881*

K.Calcium percent (Ca %)

Data in (Table 3) indicates the presence of highly significant differences among clipping times for the mineral of Ca% at both locations and their average.

Maximum percent of Ca was recorded by the treatment of first clipping time at Qlyasan location and the average of both locations with 0.590 and 0.545% respectively. While at Kanipanka location, fourth clipping time recorded the maximum Ca% with 0.629%. The minimum Ca% was produced by the treatment of fourth clipping time which was 0.175% at Qlyasan location, whereas at Kanipanka location and the average of both locations, minimum Ca% were produced by the treatment of second clipping time with 0.139 and 0.216%

respectively. Previous results indicated that as with other forages, the chemical composition varies with the growth stage of plants **(17and 18).**

L. Magnesium percent (Mg %)

Table (3) showed significant differences among clipping times due to the mineral of Mg% at Qlyasan location and the average of both locations, while in Kanipanka location there were highly significant differences among clipping times for this mineral.

At Qlyasan location, maximum Mg% was produced by the first and the third clipping times with 0.062%, whereas at Kanipanka location and the average of both locations, the maximum Mg% was produced by the fourth clipping time with 0.128 and 0.080%, respectively. The minimum Mg% was recorded by the treatment of second clipping time which was 0.022% at Qlyasan location, while the treatment of first clipping time recorded minimum Mg% at Kanipanka location and the average of both locations with 0.032 and 0.047% respectively. Previously it was calculated that at both harvest stages (early heading and milk-dough stages), Mg concentrations in all triticale varieties were between 0.064 and 0.124% **(19).**

M. Potassium percent (K %)

Data in (Table 3) revealed that there were highly significant differences among clipping times due to the mineral of K% at both locations and their average. The treatment of second clipping time gave the highest value of K% at Qlyasan location with 4.343%, whereas at Kanipanka location and the average of both locations, the highest value of K% were recorded by the first clipping time with 4.489 and 4.408% respectively. The lowest values of K% were exhibited by the treatment of fourth clipping time with 3.641, 3.259 and 3.450% at both locations and their average, respectively.

Previous workers reported that at the heading stage, K contents of triticale varieties were varied from 1.141 to 2.391%, while at the milk-dough stage they were ranged between 0.998 and 1.784% **(19).**

N. Phosphorus percent (P %)

The result of (Table 3) confirmed that the mineral of P% responded highly significant to different clipping times at both locations and their average.

Maximum values of P% were recorded by the treatment of first clipping time with 0.602, 0.565 and 0.583% at both locations and their average respectively, while the treatment of fourth clipping time gave the minimum values of P% with 0.539, 0.525 and 0.532% at both locations and their average, respectively.

In general, previous workers noticed that the stage of maturity had a dominant effect on forage quality and yield **(15),** and both forage yield and quality are very important for forage production. The plant cell wall becomes more lignified with growth stage advanced. Thus, the components of plant are less digestible and the quality becomes poor. In order to produce the forage with high yield and quality, the optimum cutting stage of each forage species is required to be determined **(20).** Also **(Wu, *etal.* 2010)** reported that early cutting showed a higher feed quality than later cutting.

Table-3: Effect of clipping times on forage quality characters at both locations and their average.

Clipping times	*Ca %*	*Mg%*	*K%*	*P %*
	Qlyasan			
1	*0.590*	*0.062*	*4.327*	*0.602*
2	*0.292*	*0.022*	*4.343*	*0.584*
3	*0.207*	*0.062*	*4.008*	*0.549*
4	*0.175*	*0.032*	*3.641*	*0.539*
$LSD_{(P<0.05)}$	*0.047*	*0.031*	*0.127*	*0.008*
Kanipanka				
1	*0.500*	*0.032*	*4.489*	*0.565*
2	*0.139*	*0.103*	*4.353*	*0.539*
3	*0.312*	*0.064*	*3.799*	*0.544*
4	*0.629*	*0.128*	*3.259*	*0.525*
$LSD_{(P<0.05)}$	*0.066*	*0.027*	*0.266*	*0.019*
Average of both locations				
1	*0.545*	*0.047*	*4.408*	*0.583*
2	*0.216*	*0.062*	*4.348*	*0.562*
3	*0.259*	*0.063*	*3.903*	*0.547*
4	*0.402*	*0.080*	*3.450*	*0.532*
$LSD_{(P<0.05)}$	*0.040*	*0.020*	*0.146*	*0.010*

Conclusion

According to the results of this study we concluded that protein and digestible protein were differed significantly among species, were barley showed its superiority in these characters and most quality traits compared to wheat and triticale, and The quality was diminished as maturity increased, the nutrient composition and forage quality of small grain plants change significantly as the plants developed. Leaves are more digestible with higher protein than stems. Thus decreasing proportion of leaves and increasing proportion of stem as the plant developed could reduce the digestibility and protein of the harvested crop; therefore, the earlier cutting dates are recommended to achieve this purpose.

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