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DETERMINATION OF FORAGE QUALITY COMPONENTS ON LESSER BURNET CULTIVARS UNDER CONDITIONS OF CENTRAL ANATOLIA, TURKEY

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Abstract

Influenced by various factors information of forage quality is essential for determination of grazing capacity. The main objective of this research was investigation on effects of phenological stages (six diffrent cutting time) on values of forage quality indices of *Sanguisorba minor* Cv. Altınova, Bunyan and Gozlu used as materials. The samples were collected from Forage Crops Experimental Gardens of the Ankara University, Turkey. They were dried, grained and analyzed against various parameters. Acid detergent fiber (ADF), NDF (neutral detergent fiber) and ADL (acid detergent Lignin Total digestible nutrients (TDN), dry matter intake (DMI) were significantly ($P<0.01$) different cultivars and six different cutting time. DMI, TDN and ADF, NDF, ADL decreased for all cultivars with plant growth development. Considering forage quality indices values among three cultivars, cv. Altınova had highest forage quality.

Keywords: *Reaping periods, sanguisorba, crude protein, crude cellulose, dry matter digestibility*

Introduction

As a perennial forage crops, Sanguisorba minor Scop. is a native plant of Turkish natural meadows. This plant begins to grow in early springs and is one of the rare plants that keeps green colour until the first day of winter. Early development of this plant during the period with a shortage of food in winter is of great value for feed-strapped animals. Its well tolerance of winter and drought, helps in preserving the bright green color during the summer and rapidly growing feature after cut, it is one of the recommended feed crops for our drought regions (Acikgoz, 2001).

The factors, effecting crop quality of plants, can be counted as cultivars of plant, the propotion of leaf/shoot, growing period, the structure of soil in use for cultivation, climate, method of harvesting, morbidity and pests (Arzani et al., 2008; Harrocks et al., 1999; McDonald et al., 1995).

It is reported that digestibilty of plants is at least 80 %, but this proportion decrases when the plant completes its growth. Fiber and lignin, increase with the period of crops' ripening, reduce the digestibility, metabolizable energy and digestible energy value of feed crop grass. In the researches of Behnamfar et al. 2009 and Holchek et al. 2004, with the plant's completing its ripening, crude protein and digestibility of feed decrease but at the same time, the proportion of ADF and NDF increases. Jafari (1993) presented in his researches that differentiation of proportion between organs in phenological growth period of plant causes this situation. Plant shoot part of plant is short and propotion of leaf/shoot is too much in early growth period. However, during the maturity, scapuses (shoot) make up significant part of total feed (Langer et al., 1979).

In general, ripening or aging of plant cell and proportion of leaves/shoot change are the reasons of change of chemical substances in plant structure, and this is able to affect grass

quality. Studies on forage poaceae and legumes support this situation. Therefore, with the increase in number of leaves/shoot the quality in terms of crude cellulose also increases in parallel way (Açıkgoz 2001).
In this research, changes in grass quality of three cultivars of Sanguisorba were tested in 6 different phenological developmental stages of plant growth.

Material and methods

The research was carried out at Forage Crops Experimental Gardens of the Ankara University, Turkey. Lesser burnet cultivars Altınova, Bunyan and Gozlu, were used as experimental material. The cultivars Altınova and Gozlu are native cultivars provided by TIGEM (Directorate General of Agricultural Products Processing). Bunyan 80 is a certificated cultivars and it was provided by Central Field Crops Research Institute.
The experimental material was planted as 3 replications using randomized complete block design on 28 March 2007 on Plot area of 5 m x 3.5 m = 17.5 m^2. Each plot contained 5 lines with line to line spacing of 70 cm. Seeds were sown by hand using 3 kg seeds in one – tenth of a hectare. Lesser burnet was harvested at 6 different phenological periods of growth during 2007-2008. The analysis was made on the samples taken from this harvest. Harvest times are presented in Table 1.

Table 1. Harvest times of study

Years	**1rd Cutting**	**2rd Cutting**	**3rd Cutting**	**4rdCutting**	**5rd Cutting**	**6rd Cutting**
2007	14 April	30 April	9 May	11 May	13 June	16 June
2008	18 April	25 April	02 May	14 May	13 June	18 June

According to soil analysis report, the soil has clayey- loamy structure, mild alkaline and mild limy. It is in harmless level in terms of salt. It is rich in potassium, poor in phosporus and very poor in organic substance. According to distribution of precipitation during long years, the year 2007 was dry and the year 2008 was very dry.
Some climatic values of study area are presented in Table 2, 3 and 4;

Table 2. Precipitation L m² and Temperature,°C (1975-2008)

	Jan.	**Feb.**	**Mar.**	**Apr.**	**May.**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
Precipitation, L m^2	41.8	36.9	38.7	49.0	1.2	35.4	14.5	10.9	18.5	30.2	33.9	46.9
Temperature ˚C	0.3	1.8	6.1	11.3	16.1	20.2	23.5	23.3	18.7	13.1	7.1	2.7

Source: General Directorate of State Meteorology Monthly Climatology Observation Scale (Anonim, 2009b)

Table 3. Precipitation, L m² (2007-2008)

Years	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May.**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
2007	39.0	16.4	37.5	23.8	17.9	31.7	3.9	9.8	0.0	19.7	66.7	44.4
2008	20.1	6.5	54.9	32.7	45.4	10.3	0.0	0.7	61.6	18.6	43.6	28.8

Source: General Directorate of State Meteorology Monthly Climatology Observation Scale (Anonim, 2009b)

Table 4. Temperature (°C) in 2007 and 2008 Years

Table 4. Temperature (°C) in 2007 and 2008 Years	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May.**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
2007	1.2	2.5	7.3	9.6	21.0	23.1	27.3	26.7	21.2	14.4	6.8	2.0
2008	3,9	0,2	10.3	14.0	16.0	22.3	25.2	27.2	20.1	13.3	8.7	2.1

Resource: General Directorate of State Meteorology Monthly Climatology Observation Scale (Anonim 2009b).

ADF, NDF, ADL

Fiber analysis was made in samples by Ankom Technology measured in conditions of ADF (acid detergent fiber), NDF (neutral detergent fiber) and ADL (acid detergent Lignin) laboratory.

TDN, DMI

Total digestible nutrients (TDN), dry matter intake (DMI), are indicator of noted grass quality, and noted were calculated with improved formula shown below (Aydın et al., 2010);

TDN = (-1.291 x ADF) + 101, 35

DMI = 120% NDF % dry matter basis

In testing, it is founded that there are 2 levels of year factor, 6 levels of harvest period factor and 3 levels of cultivars factor. Features, noted in research, were evaluated by analysis of variance technique on factorial order (SPSS, 20) and Duncan test was used while different groups was being determined. $P<0.05$ and 0.01 levels of significance.

Results and discussion

ADF (Acid Detergent Fiber)

Year x cutting x cultivars interaction among ADF value, noted from 3 different cultivars of lesser burnet in 6 different period, were found significant in ($P < 0.01$) level**.**

Table 5. Multiple comparision results related to subgroups of year x cutting x cultivars in terms of ADF value.

Years	**Cultivars**	**1 rd Cutting**	**2 rd Cutting**	**3 rd Cutting**	**4 rd Cutting**	**5 rd Cutting**	**6 rd Cutting**
2007	1.Altınova	26.7 ±0,1 Af_A	28.3 ±0,1 Ae_A	30.0 ±0,3 Ad_A	35.7 ±0.3Ac_A	40.9 ±0,4 Ab_A	45.3 ±0,3 Ba_A
2007	2.Bünyan	25.8 ±0,1 Bf_A	26.7 ±0,3 Be_A	28.3±0,2 Bd_A	33.4 ±0,3 Bc_A	37.4 ±0,2 Bb_B	46.3 ±0.2Aa_A
2007	3.Gözlü	25.6 ±0,1 Bf_A	26.6 ±0,2 Be_A	27.8 ±0,3 Bd_A	33.2 ±0,5 Bc_A	37.4 ±0,2 Bb_B	45.9 ±0,2 ABa_A
2008	1.Altınova	26.1 ±0,1 Af_A	28.1 ±0,1 Ae_A	29.8 ±0.3Ad_A	35.6 ±0,2 Ac_A	40.7 ±0,3 Ab_A	45.3 ±0,3 Aa_A
2008	2.Bünyan	25.8±0.04 Ae_A	26.5 ±0,2 Be_A	28.3 ±0.2Bd_A	33.5 ±0,3 Bc_A	40.3 ±0,3 Ab_A	46.0 ±0,3 Aa_A
2008	3.Gözlü	25.8±0,1 Af_A	26.6 ±0,1 Be_A	27.9 ±0,2 Bd_A	33.5 ±0,5 Bc_A	39.0 ±0,1 Bb_A	45.5 ±0.3Aa_A

Capital letters were used in comparing cultivars in subgroups of year x cutting time. ($P<0.05$)
Small letters were used in comparing cutting time in subgroups of year x culture variety. ($P<0.05$)
Subscripts were used in comparing years in subgoups of cultivars x cutting time. ($P<0.05$)

When Table 5 was analyzed, in subgroups of year x cutting x cultivars, on comparing the cultivars both during first year and second year in all types the highest ADF value was noted in 6rd cutting time which is the maturity period of plant and the lowest ADF value was noted in seedling period which is the youngest period of plant. On comparing cultivars, only in a year apart from 6rd cutting time, we see that Altınova cultivars gives out more than other 2 cultivars in terms of ADF in all cutting times. .

The results of ADF showed significant differences in phenological stages. Also, ADF showed an increasing trend during the development stages which is in accordance with Heshmati et al (2006).
Young plant cells have one external layer called a primary cell wall, but when they become mature, a secondary cell wall is also formed. Because of storage tissues in seeds, ADF and NDF contents varied with seed maturity between phenological stages and species. Arzani et al. (2008) also reported that with progress of plant growth, ratios of protector and firmness tissues, which mostly consist of structural carbohydrates such as celluloses, hemicelluloses and lignin, are increased. Therefore, maturity of plants and an increase in structural carbohydrates cause higher fiber amounts in forage late in the growing season.
Cassida et al. (2000) reported that, with the riping the substances like ADF and NDF, that their digestibility is hard, increase and crude protein decreases. Behnamfar et al. (2009) and Holchek et al (2004) in their research reported that ADF and NDF proportion of feed crop increase. Asaadi and Yazdi (2011), in different phenological periods, in their research which they carried out it with Sanguisorba minor and legume fodder crops, determined that as the ripening of plant increase, ADF increases, especially in seed ripening stage sanguisorba minor reaches the maximum value (50.28 %), at vegetative growth stage with 24.77 % is lowest. At flowering stage it is 35.65 %.

ADL (Acid Detergent Lignin)
Year x cutting x cultivars interaction among ADL value, noted from 3 different cultivars of lesser burnet in 6 different period, were found significant in ($P < 0.01$) level.
As it is seen in Table 6, both in first and second testing year, with the ripening of plant in continuing times we see that ADL value increases in 3 cultivars. Isselstein et al. (2003) in their research determined that a big clear difference in terms of NDF in legumes and poecea NDF value noted in summer time as regards to noted in spring as there was a very small difference between substances of crude protein related to time between legume and poecea. As NDF proportion was less than legumes forage in other family plants in terms of both cutting time, this situation in ADL value was confirmed exact opposite.

Table 6. Multiple comparision results related to subgroups of year x cutting x cultivars in terms of ADL value.

Year	Cultivars	1 rd Cutting	2 rd Cutting	3 rd Cutting	4 rd Cutting	5 rd Cutting	6 rd Cutting
2007	1. Altınova	4.7 ± 0.04 Af_A	4.8± 0.03 Ae_A	5.2±0,1 Ad_A	5.9 ±0,1 Ac_A	6.4 ±0,1 Ab_A	7.4 ±0,1 Aa_A
2007	2. Bünyan	4.3 ± 0.03 Be_A	4.5± 0.06 Be_B	4.9±0,1 Bd_A	5.7 ±0,1 Bc_B	6.3±0.1 Bb_A	7.2±0,1 Aa_B
2007	3. Gözlü	4.2 ± 0.02 Be_B	4.3±0.05 Be_B	5.0±0,1 ABd_A	5.7 ±0,1 Bc_A	6.3 ±0,1 Bb_A	7.1±0,1 Aa_A
2008	1. Altınova	4.8 ±0.06 AeA	4.9 ±0.03 Ae_A	5.4±0,2 Ad_A	6.0±0,1 Ac_A	6.6±0,1 Ab_A	7.5±0,2 Aa_A
2008	2. Bünyan	4.5±0.08 BeA	5.0±0.07 Ad_A	5.2±0,1 Ad_A	6.1±0,1 Ac_A	6.5±0,1 Ab_A	7.4±0,1 Aa_A
2008	3. Gözlü	4.8±0.05 AeA	4.9±0.06 Ae_A	5.2±0,1 Ad_A	5.7±0,1 Bc_A	6.4±0,1 Ab_A	7.1±0,1 Ba_A

Capital letters were used in comparing cultivars in subgroups of year x cutting time. ($P<0.05$)
Small letters were used in comparing cutting time in subgroups of year x culture variety. ($P<0.05$)
Subscripts were used in comparing years in subgoups of cultivars x cutting time. ($P<0.05$)

NDF (Neutral Detergent Fiber)
Year x cutting x cultivars interaction among NDF value, noted from 3 different cultivars of Lesser burnet in 6 different cutting periods, were found significant in ($P < 0.01$) level.
In Table 7. in terms of NDF value and datum of the different cutting times in two different testing years in lettering subgroups of year x cutting time interaction, in both years as it is reached to the

highest NDF value in 6rd cutting time which is the last cutting time (1. Year 54, 4 % and 2. Year 54, 4 %), the lowest NDF value (1. year 36, 2 % and 2. year % 36, 4 %) is determined early spring in both years.

Table 7. Multiple comparision results related to subgroups of year x cutting time in terms of NDF value.

Year	1 rd Cutting	2 rd Cutting	3 rd Cutting	4 rd Cutting	5 rd Cutting	6 rd Cutting
2007	36.2±0,2 Fa	37.7±0,1 Ea	38.6±0,2 Db	40.6± 0.2Cb	45.1±0,5 Ba	54.4± 0,2 Aa
2008	36.4±0,1 Fa	38.0± 0.1Ea	38.9±0,2 Da	41.3±0,2 Ca	44.9±0,5 Ba	54.4±0,2 Aa

Capital letters were used in comparing cultivars in subgroups of year x cutting time. (P<0.05)
Small letters were used in comparing years in subgroups of year x culture variety. (P<0.05)

As it is seen in Table 8, on comparing cultivars in cutting time x cultivars interaction, we see that Altınova cultivars gives out more value than other two cultivars in terms of NDF in all cutting times. On comparing cutting times in all three cultivars the lowest NDF value was determined in early spring that is the first cutting time and it was confirmed that NDF value increased through the late summer. With the beginning of plant ripening it is seen an increment in NDF value like in ADF and ADL. However, it is given in literature that less values is reached in other family plants in terms of NDF than legumes and poecea in any case.

Table 8.Multiple comparision results related to subgroups cutting time x cultivars in terms of NDF value

Cultivars	1 rd Cutting	2 rd Cutting	3 rd Cutting	4 rd Cutting	5 rd Cutting	6 rd Cutting
1. Altınova	36.9±0,1 Af	38.4±0,1 Ae	39.8±0,2 Ad	41.9±0,2 Ac	47.6±0,3 Ab	54.9±0.2Aa
2. Bünyan	36.1±0,1 Bf	37.6±0,1 Be	38.3±0,1 Bd	40.6±0,2 Bc	43.7±0,3 Bb	54.2±0,1 Ba
3. Gözlü	35.9±0,1 Bf	37.5±0,1 Be	38.1±0,2 Bd	40.3±0,2 Bc	43.7±0,2 Bb	54.1±0,2 Ba

Capital letters were used in comparing cultivars in subgroups of year x cutting time. (P<0.05)
Small letters were used in comparing cutting time in subgroups of cutting time x culture variety. (P<0.05)

Isselstein et al. (2003) in their research, as there is a small difference among substances of crude protein related to time in between legumes and poecea. There is a clear difference in NDF values noted in summer period in legumes and poecea in terms of NDF as compared to early spring.

DMI (Dry Matter Intake)

Year x cutting x cultivars interaction among DMI value, noted from 3 different cultivars of lesser burnet in 6 different period, were found significant in (P < 0.01) level.

As it is seen in Table 9, in year x cutting time interaction in first and second testing year, as it is not seen a difference as statistical on dry matter intake between first cutting time and the last two cutting times, a difference is determined on behalf of first testing year among years in 2. , 3rd and 4rd cutting times.

Table 9. Multiple comparision results related to subgroups of year x cutting time in terms of DMI value.

Year	1 rd Cutting	2 rd Cutting	3 rd Cutting	4 rd Cutting	5 rd Cutting	6 rd Cutting
2007	3.31±0.014 Aa*	3.19±0.009 Ba	3.11±0.019 Ca	2.96±0.016 Da	2.67±0.028 Ea	2.02±0.007 Fa
2008	3.30±0.013 Aa	3.16±0.010 Bb	3.08±0.015 Cb	2.91±0.013 Db	2.68±0.029 Ea	2.21±0.006 Fa

Capital letters were used in comparing cutting times in subgroups of year x cutting time.(P<0.05).
Small letters were used in comparing years in subgroups of cutting time x year(P<0.05).
*subscript

As it is seen in Table 10, that shows the results of interaction between cutting time x cultivars, the 3. Cultivar Gozlu gives out a higher value of dry matter intake than other two cultivars in all cutting times. However, we follow that this value indicates a decline in per cultivars following harvest dates.

Table 10.Multiple comparision results related to subgroups of cultivars x cutting time in terms of DMI value

Cultivars	1 rd Cutting	2 rd Cutting	3 rd Cutting	4 rd Cutting	5 rd Cutting	6 rd Cutting
1. Altınova	3.25±0.005 Ca*	3.12±0.007 Bb	3.02±0.013 Bc	2.86±0.011 Bd	2.52±0.016 Be	2.19±0.007 Bf
2.Bünyan	3.33±0.013 Ba	3.19±0.008 Ab	3.13±0.010 Ac	2.96±0.011 Ad	2.75±0.018 Ae	2.22±0.006 Af
3.Gözlü	3.35±0.012 Aa	3.19±0.009 Ab	3.15±0.014 Ac	2.98±0.013 Ad	2.74±0.012 Ae	2.22±0.008 Af

Capital letters were used in comparing cultivars in subgroups of cultivars x cutting time (P<0.05).
Small letters were used in comparing cutting times in subgroups of cutting time x culture variety (P<0.05).
*subscript

Drerup (2008) in the research that he carried out in forage poeceae, determined big differences among noted grass quality in terms of feeding although he made both two harvest in May. It is determined that there is a higher dry matter intake (DMI) in early harvest (in the beginning of May) than in the last of the May because of substances of crude protein and it offers a higher digestibility. However it is determined that one of the handicaps in the earliest harvest is the low proportion of sugar in fodder, it is necessary a supporting for bacteria using this sugar in rumen, and in this situation it is probable that a high feed consumption. For instance; it is determined an aging tendency in second harvest distinctly made only 6 weeks after first harvest.
As the proportion of plant cell wall in the diet increases, both these rates decrease; in the diet increases, both these rates decrease; therefore, the amount of cell wall accounts for a large proportion of the variation in intake (Van Soest, 1982; Waldo, 1986).

TDN (Total Digestible Nutrients)

Year x cutting time x variety interaction among TDN values obtained from 3 different lesser burnet cultivars in 6 different periods is considered significant at a level of ($P < 0.01$).
As is seen from Table 11, in year x cutting x variety interaction, Bunyan and Gozlu cultivars have fallen within the same subgroup statistically in both experimentation years with the except of the last harvest-time; only in the second experimentation year every tree cultivars have fallen within the same subgroup. For every 3 cultivars, the decrease is determined in the rates of Total digestible nutrients procurement from the harvest-time in early period to the harvest-time in ripening period.

Table 11. Multiple comparisons results of Year x cutting x variety subgroups in regard to TDNvalue

Year	Cultivars	1rd Cutting	2 rd Cutting	3 rd Cutting	4 rd Cutting	5 rd Cutting	6 rd Cutting
2007	1.Altınova	66.9±0.155 B a_{A*}	64.8±0.2 Bb_A	62.6±0.4 Bc_A	55.4±0.4 Bd_A	48.6±0.5Be_A	42.9±0.4 Af_A
	2.Bünyan	68.1±0.104 Aa_A	66.9±0.3 Ab_A	64.8±0.3 Ac_A	58.2±0.4 Ad_A	53.0±0.3 Ae_A	41.5±0.2Bf_A
	3.Gözlü	68.2±1.00 Aa_A	67.5±0.2 Ab_A	65.5±0.3 Ac_A	58.5±0.6 Ad_A	53.1±0.2Ae_A	42.2±0.3ABf_A
2008	1. Altınova	67.6±0.161 Aa_A	65.1±0.2 Bb_A	62.9±0.4 Bc_A	55.4±0.3 Bd_A	48.8±0.4 Be_A	42.9±0.3 Af_A
	2 .Bünyan	67.9±0.056 Aa_A	67.1±0.3 Ab_A	64.8±0.2 Ac_A	58.0±0.4 Ad_A	49.3±0.4 Be_B	42.0±0.3 Af_A
	3.Gözlü	68.1±0.135 Aa_A	66.9±0.1 Ab_A	65.3 ±0.2 Ac_A	28.1±0.6 Ad_A	51.1±0.2 Ae_B	42.7±0.4 Af_A

Capital letters are used for the comperison of year x cutting time subgroup varieties (P<0.05)
Lower case are used for the comperison of year x cutting time of variety subgroups (P<0.05)
Subcripst are used for the comperison of variety x cutting time of supgroups (P<0.05)
*subscript

Total digestible nutrients report the % age of digestible material in forage. Total digestible nutrients are calculated from acid detergent fiber and express differences in digestible material between forages (Henning et al 1991). TDN is often used as an estimate of the energy value of forage and can be used in ration formulation.

Typically, the greater the value, the more energy-dense the feedstuff is considered. Typically, lower quality hays are in the 40 to 50 % TDN range, while higher quality hays are in the 50 to 60 % TDN range. In some cases, certain hays and legumes can be in the 60 to 70 % TDN range.

Conclusions

Range forage quality has spatial and temporary variations. The chemical analysis of range forage plants serves as a comparative measure of differences between species and changes with season or phenology.

By this experiment on 3 different lesser burnet cultivars in 6 different cutting time which the variation of hay quality of forage is studied in conditions of Ankara, stated that, mainly hay quality of forage and nutritional value, how the plant depends on the harvest date and and an increase would be provided at the animal performance with a proper harvest date by going with the phonological periods of the plant.

As plants mature, they increase in fiber and lignin content. Increasing fiber (ADF and NDF) reduces digestibility and intake potential. Lignin is essentially indigestible and therefore, the increasing lignin content that comes with increasing maturity also reduces digestibility. For each one percentage unit increase in lignin, digestible dry matter (DDM) decreases three to four percentage units. Increase in crude fibre ratio influence highly the crude protein ratio and caused for decline in general.

This study suggests that Phenological stage of growth had a significant influence on forage quality. The close matching of nutrient requirements and feed quality is necessary for efficient animal production. Higher forage quality was recorded for the 1st stage of growth.

References

Acikgoz E. (2001): Forage Crops.(Yem Bitkileri) Uludag Universitesi Guclendirme Vakfı Yayin No: 182. Vipas AS Yayin No: 58. 584pp. (In Turkish).

Asaadi A. M., Yazdi A. K. (2011): Ecological Characteristics dracocephalum kotschyiboiss.In Bojnord rangelands watershed management researches (Pajouhesh-Va-Sazandegi) 2011; - (1 (90)); 11-18.

Åman P., Lindgren E. (1983): Chemical Composition and in-vitro degradability of individual chemical constituents of six Swedish grasses harvested at different stages of maturity. Swed. J. Agric. Res., 13, 221-227.

Åman P., Nordkvist E. (1983): Chemical composition and in-vitro degradability of major chemical constituents of red clover harvested at different stages of maturity. J. Sci. Food Agric. 34, 1185-1189.

Anonim (2009b). General Directorate of State Meteorology Monthly Climatology Observation Scale.

Arzani H., Sadeghimanesh M. R., Azarnivand H., Asadian G. H., Shahriyari E. (2008): Study of phenological stages effect values of twelve species in Hamadan rangelands. Iranian Journal of Range and Desert Research 16(1):86-95.)

Aydın N., Mut Z., Mut H., Ayan I. (2010): Effect of autumn and spring sowing dates on hay yield and quality of oat (Avena sativa L.) genotypes. Journal of Animal and Veterinary Advances 9(10):1539-1545.

Beever D. E., Offer N., Gill M. (2000): The feeding value of grass and grass products, Printed in: Grass, Its production and utilization" (A. Hopkins), Institute of Grassland and Enviromental Research, North Wyke , Okehampton , Devon , UK , 140-190.

Behnamfar K., Siadat S. A., Salehe M. H. (2009): Comparison of nutritional values of important range species in semi warm steppe rangeland of Khouzestan. Iranian Journal of Range and Desert Research 16(1):86-95.

Cassida K. A., Griffin T. S., Rodriguez J., Patching S. C., Hesterman O. B., Rust S. R.(2000): Protein degradability and forage quality in maturing Alfalfa, Red Clover and Birdsfoot Trefoil. Crop Science. 40: 209-215

Drerup C. (2008): Okoteam Chamber of Agriculture (Okoteam Landwirtschaftskammer) NRW, MIR Nr. 18/08. (In German)

Harrocks D., Valentine J. F. (1999): Harvested Forage. Academic Press, San Diego, CA, 425 p.

Henning P. H., Steyn D. G., Meissner H. H. (1991): The effect of energy and nitrogen supply pattern on rumen bacterial growth in vitro. Anim. Prod. 53.165-175.

Heshmati G. A., Baghani M., Bazrafshan O. (2006): Comparison of nutritional values of 11 rangeland species in eastern part of Golestan Province. J. Pajouhesh & Sazandegi 73(4):90-95.

Holchek J. I., Herbal C. H., Pieper R. D. (2004): Range Management Principles and Practices. 4th edn. Prentice Hall, USA. 587 p.

Isselstein, J., Bonorden, S., Seng, M., Abel, Hj., 2003. Nutrient availability and nutrient use of clover and herb-rich growths organically farmed grassland along the production chain generation? Preservation? (Nährstoffverfügbarkeit und Nährstoffnutzung von klee- und kräuterreichen Aufwüchsen ökologisch bewirtschafteten Grünlandes entlang der Produktionskette Erzeugung? Konservierung?) Verdauung. In: Organic E-prints, http://orgprints.org/7040, 23 S (In German)

Jafari M. (1993): Determination of dry matter digestibility of some rangeland species by in vitro analysis. Journal of Pejouhesh and Sazandegi 18:66– 68.

Jung H. G., Deetz D. A. (1993): Cell wall lignification and degradability. In: H. G. Jung, D. R. Buxton, R. D. Hatfield, and J. Ralph (Ed.) Forage Cell Wall Structure and Digestibility. P 315-346. ASA-CSSA-SSSA, Madison, WI

Langer R. H. M. (1979): How Grasses Grow. 2nd edn. Edward Arnold, London, UK. Translated by S. Sanadgol 1989. Institute of Forests and Rangelands of Iran, Tehran, Iran, 114 p.

Mcdonald P., Edvards R. A., Greenhalgh J. F. D., Morgan C. A. (1995): Animal Nutrition. 5th edn. Longman Scientific & Technical, New York, NY, 597 p.

Van Soest P. J. (1982): Nutritional Ecology of the Ruminant. Cornell University Press, Ithaca, New York, 137 p.

Waldo D. R. (1986): Effect of forage quality on intake and forage concentrate interactions. J. Dairy Sci. 69:617.