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Effect of Nitrogen Fertilizer and Clipping Times on Forage Quality of Two Fenugreek (*Trigonellafoenum-graecum*) Varieties under Rainfed Condition of Sulaimani Region.

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Abstract

A field experiment was laid out at College of Agricultural Sciences University of Sulaimani, during the winter season of 2014 – 2015 to study the effect of nitrogen fertilizer and clipping times on forage quality of two fenugreeks (*Trigonellafoenum-graecum* L.) varieties under rainfed condition using split-split plots based on randomized complete block design (RCBD) with 3 replications. Two varieties of Fenugreek (Mithe and EP 101) were allotted in the main plots and two levels of nitrogen fertilizer (0 and 40 kg/ha) in subplots and two clipping times as sub-sub-plots were investigated.

The results indicated to significant effect of varieties on some quality traits (Protein, Digestible, protein and NDF) % only, EP101 variety recorded the highest percent of Protein and NDF (27.54 and 26.97) % respectively,while the highest Digestible Protein trait, the maximum percent was 83.42% exhibited by Mithe variety, while minimum value (83.04%) was obtained by EP101 variety. The nitrogen fertilizer affected significantly on (Fiber, ADF, NDF, ADL, K P) % and (Ca, Mg) % only. The highest values of them were (4.619, 14.56, 27.47, 3.140, 4.294 , 0.438) % and (0.272 and 0.210)% which were recorded from treatments N40 and N0 respectively, .The effect of clipping times on all forage quality traits was significant except (Fat, Ash, Ca and P)% which were not significant, first clipping time exhibited maximum percent of (Protein, DP, Fiber and Mg) which were (27.86%, 85.02%, 4.118%, and 0.213%) respectively, but the traits (ADF%, NDF%, Lignin%, ADL% and K%), recorded the highest values (16.89%, 28.12%, 1.663% 3.752% and 4.249%) respectively at second clipping time. The interaction among verities, nitrogen and clipping time affected only on protein, fat and Mg%.

Introduction

Fenugreek (*Trigonellafoenum- graecum L.*) is an annual legume crop native to Asia and southeast Europe [1] that historically has been used for medicinal as well as culinary herb purposes, the potential of fenugreek as a forage crop for livestockin the northern Great Plainswas studied in Canada.Fenugreek forage is non-bloating, making it an attractive forage crop for the cattle industry [1]. The nutritive value of fenugreekforage was greater or comparable to alfalfa (*Medicago sativa* L.) when harvested at the early bloomstage [2]. It is cultivated especially in the regions of the North of Tunisia [3] and generally used as a spice in food preparation for its nutritive and restorative properties and has been used in people medicine for centuries for a wide-ranging of diseases inclusive diabetes [4]. Apart from its high-quality forage production, fenugreek can fixnitrogen (N) and help maintain soil health and quality like alfalfa and other legumes. Fenugreek provides an optionfor producers who want to take advantage of nitrogen fixation from forage legumes to reducenitrogen fertilizer inputs [5].

The seed of fenugreek is produced for many purposes such as a vegetable for humans, as a spice, as forage for cattle, and for the medicinal destination. Also, it is incorporated into the short-term rotation for hay and silage (livestock feed), and for soil fertility (nitrogen fixation) [6]. To obtain economically sustainable yields, essential nutrients like nitrogen and phosphorous must occur in sufficient available quantities in the soil for root uptake [7-9]. When plants are clipping or grazing due to losses some nutrients, thus fertilizers must apply to replace the lost nutrients [10].

All forage plants are composed of cells having fibrous cell walls for support and protection. Acid detergent fiber (ADF) is composed of highly indigestible fiber and relates negatively to forage digestibility [11-12]. Neutral detergent fiber (NDF) consists of the total fiber in forage and relates to forage intake by ruminants [11-13]. Digestible dry matter (DDM) is the digestibility of forage, is often calculated from ADF of forages [11] and [14]. Relative feed value (RFV) index is an important nutritional factor [14]. The total nitrogen concentration used for estimate crude protein content multiplying that by 6.25 in the forage is important since adequate intake of nitrogen is essential for animal productivity [15]. A lot of the protein in forages is degraded by bacteria in the rumen. These bacteria use this protein for growth and digestion of fiber in the forage [16].

Forage crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrient (TDN) concentrations, and relative feed value (RFV) did not differ ($P > 0.05$) among fenugreek cultivars. However, Ca and K concentrations differed among the cultivars. P and Mg levels did not differ ($P > 0.05$) among the cultivars [5]. Crude protein, ADF and NDF content in forage can change with chemical fertilization [16-17]. Also, digestible dry matters and relative feed values, calculated from ADF, NDF, and crude protein values, can be affected by fertilization.

The goal of this research is to develop agronomic production recommendations for potential adaptation of fenugreek to Sulaimani growing conditions.A specific objective was to determine the effect of nitrogen fertilizer and clipping times on forage quality of two fenugreeks (*Trigonellafoenum-graecum L.*) varieties under rainfed condition of Sulaimani region.

Materials and Methods

A field experiment was laid out at College of Agricultural Sciences-University of Sulaimaniwith GPS reading of (Latitude: 35˚ 33′; N, Longitude 45˚ 27′; E, at altitude of 830 m above sea level) during the winter season of 2014-2015, to study the effect ofnitrogenfertilizer and clipping times on forage quality of two fenugreeks (*Trigonellafoenum-graecum* L.) varieties under rainfed condition of Sulaimani region conducted in split-split plot design. Two varieties of Fenugreek (Mithe and EP 101) were implemented in the main plots and arranged according to CRBD and replicated three times, two levels of nitrogen (0 and 40 kg/ha) allotted in subplots, and two clipping times as sub sub-plots were investigated which consisted of {clip 90 days after sowing (clip1), clip 110 days after sowing (clip2)}, dated March 17 and April 7 respectively. Each sub-sub-plots consist of 4 rows, 2m length with 0.30m space between rows.

Sowing was carried out during Dec.18 of 2014 according to the recommended seed rates 25Kg/ha for both used varieties and recommended the dose of fertilizer was used 40 kg N/ha by two doses, the first dose at sowing seeds and the second dose after 30 days of sowing. All plots were fertilized with 20Kg P_2O_5/ha as triple superphosphate, which was broadcasted before sowing. All required agricultural practices were done whenever needed Forage clipping was conducted at the (6-8) cm height from the soil surface to estimate the nutrient content of the forage or (quality traits) after it had been dried in an oven at ($65C^0$) for 72 hours.

A. Studied traits:

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

Protein%, Digestible Protein%, Fiber%, Acid Detergent Fiber (ADF %), Neutral Detergent Fiber (NDF%), Lignin%, Acid Detergent Lignin (ADL%),Fat%, Ash%, Calcium%, Magnesium%, Potassium%, andPhosphorus%.

B. Chemical analysis:

Analysis of plant samples 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:

All data were analyzed statistically according to the methods of analysis of variance as a general test, and means comparison was carried out using the least significant difference test (LSD) at 0.01 significant levels, since there are no significant differences for most of lab traits at 0.01 for this reason the 0.05 was applied [18].

Results and Discussion

Effect of varieties on forage quality traits of fenugreek.

Data in table 1 and appendix1 showed that varieties affected significantly on (Protein and Digestible Protein) and highly significantly on NDF % only, EP101 variety gave the highest percent of Protein and NDF were (27.54 and 26.97) % respectively, in compare to Mithe variety which was recorded the lowest percent of these both traits were (26.81 and 25.83) % respectively. Regarding Digestible Protein trait, the maximum percent was 83.42% exhibited by Mithe variety, while minimum Digestible Protein percent 83.04% obtained by EP101 variety.

The differences between the two varieties in these traits may be due to their differences in the relative performance of each genotype. This result was agreed with the finding of [19-20]. Previously [5] stated that forage crude protein (CP), neutral detergent fiber (NDF),acid detergent fiber (ADF), total digestible nutrient (TDN) concentrations, and relative feed value (RFV) also P and Mg levels did not differ among the fenugreekcultivars. However, Ca and K concentrations differed among the cultivars [5].

Table 1: Effect of varieties on forage quality traits of fenugreek.

Varieties	*Protein*	*DP*	*Fiber*	*ADF*	*NDF*	*Lignin*	*ADL*	*Fat*	*Ash*	*Ca*	*Mg*	*K*	*P*
							%						
Mithe	*26.81*	*83.42*	*2.95*	*13.67*	*25.83*	*0.985*	*2.844*	*0.121*	*10.92*	*0.173*	*0.202*	*3.803*	*0.429*
EP 101	*27.54*	*83.04*	*4.18*	*13.95*	*26.97*	*0.825*	*3.157*	*0.086*	*10.80*	*0.181*	*0.185*	*3.912*	*0.422*
LSD (0.01)	*N.S*	*N.S*	*N.S*	*N.S*	*0.800*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*
LSD (0.05)	*0.552*	*0.304*	*N.S*	*N.S*	*0.347*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*

N.S: Not Significant

Effect of nitrogen fertilizer on forage quality traits of fenugreek.

Data represented in table 2 and appendix1 showed that the effect of nitrogen fertilizer on forage quality characters of fenugreek were highly significant for must traits such as (Fiber, NDF, ADL, Ca, Mg, K, and P), while for ADF%was significant only, but for other traits (Protein, Digestible Protein, Lignin, Fat and Ash) % was found to be not significant.

The level of nitrogen fertilizer (N40) gave maximum value of these traits (Fiber, NDF, ADL, K, and P) % were (4.619, 27.47, 3.140, 4.294 and 0.438) % respectively and 14.56% of ADFin compare to no fertilization (N0) which was recorded minimum values of these traits (2.506, 25.33, 2.861, 3.420 and 0.413) % regularly, and 13.06% for ADF. But concerning Ca and Mg percent, the treatment of control or N0 gave the highest percent were 0.272 and 0.210% respectively, while the lowest percent exhibited by N1(40Kg/ha) were 0.081 and 0.177% respectively,the most interesting point was 3.36 decrease in Ca content of plant in case of

application 40 kg N/ha,this may be due to conversion of the applied nitrogen to NH_4^+ form which caused decrease in absorption and uptake of Ca by plant. Nitrogen is a building block of amino acids and protein in plants, chlorophyll is the most abundant protein in the plant, it is involved in photosynthesis and increasing vegetative growth [21-22].On the other hand, [13] stated that fertilization had positive effects on the crude protein content of forage, NDF content was increased, and ADF content was decreased by fertilization. The decrease in ADF, cause to increase in TDN, can be positive for forage quality because the lower ADF content means the higher digestion. High NDF content has negative effects on forage quality but the results in this study showed that NDF content increased by fertilization was not significant for quality, such as my finding in this study.

Table 2: Effect of nitrogen fertilizer on forage quality traits of fenugreek.

N.F. level (kg/ha)	***Protein***	***DP***	***Fiber***	***ADF***	***NDF***	***Lignin***	***ADL***	***Fat***	***Ash***	***Ca***	***Mg***	***K***	***P***
						%							
N0 (0)	*26.85*	*83.26*	*2.506*	*13.06*	*25.33*	*0.790*	*2.861*	*0.070*	*10.70*	*0.272*	*0.210*	*3.420*	*0.413*
N1 (40)	*27.50*	*83.20*	*4.619*	*14.56*	*27.47*	*1.020*	*3.140*	*0.138*	*11.02*	*0.081*	*0.177*	*4.294*	*0.438*
LSD (0.01)	*N.S*	*N.S*	*0.612*	*N.S*	*0.439*	*N.S*	*0.065*	*N.S*	*N.S*	*0.115*	*0.014*	*0.399*	*0.011*
LSD (0.05)	*N.S*	*N.S*	*0.369*	*0.931*	*0.265*	*N.S*	*0.039*	*N.S*	*N.S*	*0.069*	*0.009*	*0.240*	*0.007*

N.S: Not Significant

Effect of clipping times on forage quality traits of fenugreek.

The results of table 3 and appendix 1 confirmed that the effect of clipping times on all forage quality traits was highly significant except protein percent was significant only but this effect on the rest traits (Fat, Ash, Ca and P%) were not significant.

First clipping time exhibited the maximum percent of (Protein, DP, Fiber and Mg) were (27.86%, 85.02%, 4.118%, and 0.213%) respectively, while the second clipping time recorded minimum value for these traits with (26.49%, 81.44%, 3.007%, and 0.173%) respectively.

Regarding the other traits (ADF%, NDF%, Lignin%, ADL% and K%), the second clipping time exceeded the first clipping treatment significantly and gave maximum values (16.89%, 28.12%, 1.663% 3.752% and 4.249%) respectively in compare to first clipping time which was recorded minimum values with (10.73%, 24.68%, 0.147%, 2.249% and 3.465%) for these previous traits. These maximum values for these quality parameters (Protein, DP, Ash, and Fat %) were higher at the early growth stage may be due to higher leaf/stem ratio, in which the leaves contain more protein and low fiber. This result in agreement with the result of (23 and 24), and (12 and 13) stated that forage quality declines with advancing maturity because of the proportion of leaves, with higher in quality than stems, in forage declines as the plant matures. Likewise, the plants grow at higher temperatures; they can produce less leaf material, these previous findings agree with my result.

Table 3: Effect of clipping times on forage quality traits of fenugreek

Clipping Times	Protein	DP	Fiber	ADF	NDF	Lignin	ADL	Fat	Ash	Ca	Mg	K	P
						%							
First Clip 17/3/2015	27.86	85.02	4.118	10.73	24.68	0.147	2.249	0.079	10.65	0.169	0.213	3.465	0.434
Second Clip 7/4/2015	26.49	81.44	3.007	16.89	28.12	1.663	3.752	0.128	11.07	0.184	0.173	4.249	0.417
LSD (0.01)	N.S	0.665	0.921	0.807	0.807	0.668	0.163	N.S	N.S	N.S	0.013	0.379	N.S
LSD (0.05)	1.150	0.457	0.633	0.555	0.555	0.459	0.112	N.S	N.S	N.S	0.009	0.261	N.S

N.S: Not Significant

Effect of interactions between varieties and nitrogen fertilizer on forage quality traits of fenugreek.

The following data in table 4 and appendix 1 represent the effect of interactions between varieties and nitrogen fertilizer on forage quality traits of fenugreek which was not significant for all traits except two traits (NDF% and ADL%) which were found to be highly significant.

The interaction between EP101 variety and nitrogen fertilizer (40kg/ha) registered the highest percent of NDF and ADL percent were 28.29% and 3.346% respectively, on the other hand, the lowest percent of both traits were 25.01% and 2.753% obtained by the interaction between Mithe variety and no fertilizer application (0 kg N/ha).Results of previous works showed that crude protein, NDF, and ADF content in forage can change with chemical fertilization [16-17]. Also, digestible dry matters and relative feed values, calculated from ADF, NDF, and crude protein values, can be affected by fertilization.

Table 4: Effect of interactions between varieties and nitrogen fertilizer on forage quality traits of fenugreek.

Varieties	N. F. level (kg/ha)	Protein	DP	Fiber	ADF	NDF	Lignin	ADL	Fat	Ash	Ca	Mg	K	P
							%							
Mithe	N0 (0)	26.62	83.47	1.969	13.34	25.01	1.011	2.753	0.033	10.86	0.275	0.218	3.397	0.418
	N1 (40)	27.00	83.37	3.933	13.99	26.65	0.959	2.935	0.210	10.98	0.070	0.185	4.208	0.440
EP 101	N0 (0)	27.07	83.05	3.044	12.78	25.65	0.569	2.968	0.107	10.54	0.268	0.202	3.443	0.408
	N1 (40)	28.00	83.02	5.306	15.12	28.29	1.080	3.346	0.066	11.07	0.093	0.168	4.380	0.435
LSD (0.01)		N.S	N.S	N.S	N.S	0.621	N.S	0.092	N.S	N.S	N.S	N.S	N.S	N.S
LSD (0.05)		N.S	N.S	N.S	N.S	0.375	N.S	0.055	N.S	N.S	N.S	N.S	N.S	N.S

N.S: Not Significant

Effect of interactions between varieties and clipping times on forage quality traits of fenugreek

Results of table 5 and appendix 1 confirmed that the effect of interactions between varieties and clipping times on two forage quality traits (Fiber and ADF) %was highly significant in which on the traits (DP, NDF, and ADL) % only significant, but this effect on the rest traits (Protein, Lignin, Fat, Ash, Ca, Mg, K, and P) % were not significant.

Maximum digestible protein percent showed by the interaction between EP101 variety and first clipping time was 85.07%, in which the interaction between EP101 and second clipping time recorded minimum percent of digestible protein was 81.00%, because the protein content at the time of first clipping was high but fiber content was low, thus digestibility was increase, while the opposite result were occurring at the time of second clipping, when the plant closing to the maturing stage which decrease protein content and increase fiber content will cause decreasing in digestibility. but concerning the other traits (Fiber%, ADF%, NDF% and ADL%) the best percent exhibited by the interaction of EP101 variety with second clipping time were (4.507, 17.56, 29.07 and 3.988) % respectively, while the interaction between Mithe variety and second clipping time gave minimum percent of fiber was 1.508%, and EP101 variety with first clipping time interaction registered the lowest value of ADF percent (10.34%), but regarding both traits NDF and ADL percent, minimum values were obtained by interaction of Mithe variety with first clipping time was 24.49% and 2.171% properly. Similar results were obtained by [25-27] confirmed that the varieties harvested at the booting stage had lower ADF compared to those harvested at the soft dough stage, also reported that reflecting the decline in percent protein and fiber digestibility that occur as the plant matures.

Previously it was noticed that harvest treatments and varieties affected significantly on the value of crude Fat content (CF), meanwhile, there were significant interaction effects between harvest treatments and varieties on this quality parameter [28].

Table 5: Effect of interactions between varieties and clipping times on forage quality traits of fenugreek.

Varieties	***Clipping Times***	***Protein***	***DP***	***Fiber***	***ADF***	***NDF***	***Lignin***	***ADL***	***Fat***	***Ash***	***Ca***	***Mg***	***K***	***P***
							%							
Mithe	*First Clip 17/3/2015*	*27.25*	*84.96*	*4.394*	*11.12*	*24.49*	*0.208*	*2.171*	*0.081*	*10.85*	*0.165*	*0.223*	*3.427*	*0.438*
	Second Clip 7/4/2015	*26.38*	*81.88*	*1.508*	*16.21*	*27.16*	*1.762*	*3.517*	*0.162*	*10.99*	*0.180*	*0.180*	*4.178*	*0.420*
EP 101	*First Clip 17/3/205*	*28.48*	*85.07*	*3.843*	*10.34*	*24.86*	*0.086*	*2.326*	*0.078*	*10.46*	*0.173*	*0.203*	*3.503*	*0.430*
	Second Clip 7/4/2015	*26.60*	*81.00*	*4.507*	*17.56*	*29.07*	*1.563*	*3.988*	*0.095*	*11.15*	*0.188*	*0.167*	*4.320*	*0.413*
LSD (0.01)		*N.S*	*N.S*	*1.303*	*1.142*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*
LSD (0.05)		*N.S*	*0.646*	*0.896*	*0.785*	*0.785*	*N.S*	*0.158*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*	*N.S*

N.S: Not Significant

Effect of interactions between nitrogen fertilizer and clipping times on forage quality traits of fenugreek.

Table 6 and appendix 1 indicated that theeffect of interactions between nitrogen fertilizer and clipping times on these forage quality traits of fenugreek (Protein, Dp, NDF, ADL, Ca, and P) %were highly

significant and on (Fiber, Ash, and K) % was significant only but on the other traits (ADF, Lignin, Fat and Mg) % this effect was not significant.

Maximum Protein%, DP%, Fiber% and P% exhibited by the interaction between N1 (40kg/ha) and first clipping time were 30.28%, 85.58%, 4.843%, and 0.460% respectively, but concerning NDF%, ADL% and K% the highest values recorded by the interaction of N1(40kg N/ha) with second clipping time were 29.63%, 3.980%, and 4.530% regularly. Previously [28] reported that early cutting showed a higher feed quality than later cutting.

Table 6: Effect of interactions between nitrogen fertilizer and clipping times on forage quality traits of fenugreek.

N. F. level (kg/ha)	*Clipping Times*	*Protein*	*DP*	*Fiber*	*ADF*	*NDF*	*Lignin*	*ADL*	*Fat*	*Ash*	*Ca*	*Mg*	*K*	*P*
							%							
N0 (0)	*First Clip 17/3/2015*	*25.45*	*84.45*	*3.394*	*9.821*	*24.05*	*0.049*	*2.196*	*0.038*	*10.05*	*0.220*	*0.232*	*2.872*	*0.408*
	Second Clip 7/4/2015	*28.25*	*82.07*	*1.619*	*16.29*	*26.61*	*1.532*	*3.525*	*0.102*	*11.34*	*0.323*	*0.188*	*3.968*	*0.418*
N1 (40)	*First Clip 17/3/205*	*30.28*	*85.58*	*4.843*	*11.64*	*25.31*	*0.246*	*2.301*	*0.121*	*11.25*	*0.118*	*0.195*	*4.058*	*0.460*
	Second Clip 7/4/2015	*24.73*	*80.81*	*4.396*	*17.48*	*29.63*	*1.793*	*3.980*	*0.155*	*10.80*	*0.045*	*0.158*	*4.530*	*0.415*
LSD (0.01)		*2.367*	*0.940*	*N.S*	*N.S*	*1.142*	*N.S*	*0.230*	*N.S*	*N.S*	*0.116*	*N.S*	*N.S*	*0.037*
LSD (0.05)		*1.627*	*0.646*	*0.896*	*N.S*	*0.785*	*N.S*	*0.158*	*N.S*	*0.900*	*0.080*	*N.S*	*0.369*	*0.026*

N.S: Not Significant

Effect of interactions between varieties, nitrogen fertilizer and clipping times on forage quality traits of fenugreek.

This interaction was represented in Table 7 and appendix 1 confirmed that the effect was not significant for all forage quality traits except some characters such as Protein% and Mg% which were affected significantly and on Fat% highly significantly affected by the mentioned interaction.

Regarding protein percent, the maximum value was obtained from the interaction among EP101 variety, N1 (40kg N/ha) and first clipping time which was 31.72%, while the minimum percent of protein was 24.29% recorded by interaction among EP101 variety, N1 (40kg N/ha) and second clipping time.

Concerning Fat percent character, the interaction among Mithe variety, N1 (40kg N/ha) and second clip gave the highest value of Fat% with 0.290%, in which the lowest percentage of this trait was 0.020% exhibited by EP101 variety when interacted with N1 (40kg N/ha) and second clipping time.

At last, about Magnesium percent, maximum percent was 0.237% registered from the interaction among Mithe variety, N0 (no fertilizer application) and first clipping time, on the other hand, when Mithe variety interacted with N1 (40kg N/ha) and second clipping time gave minimum percent of Magnesium (0.160%). Generally, previous workers noticed that the stage of maturity had a dominant effect on forage quality and yield [27], and the plant cell wall becomes more lignified with growth stage advanced. Thus, the plant components are less digestible and the quality becomes poor. In order to produce the forage with higher yield and quality, the optimum cutting stage of each forage species is required to be determined [24].

Table 7: Effect of interactions between varieties, nitrogen fertilizer and clipping times on forage quality traits of fenugreek.

Varieties	N. F. level (kg/ha)	Clipping Times	Protein	Dp	Fiber	ADF	NDF	Lignin	ADL	Fat	Ash	Ca	Mg	K	P
								%							
Mithe	N0 (0)	First Clip 17/3/2015	25.66	84.24	3.445	10.90	24.15	0.066	2.129	0.032	10.15	0.220	0.237	2.827	0.417
		Second Clip 7/4/2015	27.58	82.71	0.492	15.78	25.87	1.957	3.377	0.033	11.56	0.330	0.200	3.967	0.420
	N1 (40)	First Clip 17/3/2015	28.84	85.69	5.342	11.35	24.83	0.351	2.213	0.130	11.54	0.110	0.210	4.027	0.460
		Second Clip 7/4/2015	25.17	81.06	2.524	16.64	28.46	1.567	3.657	0.290	10.42	0.030	0.160	4.390	0.420
EP101	N0 (0)	First Clip 17/3/205	25.24	84.67	3.343	8.75	23.94	0.031	2.264	0.043	9.955	0.220	0.227	2.917	0.400
		Second Clip 7/4/2015	28.91	81.44	2.746	16.80	27.36	1.107	3.673	0.170	11.13	0.317	0.177	3.970	0.417
	N1 (40)	First Clip 17/3/2015	31.72	85.48	4.344	11.92	25.79	0.141	2.389	0.113	10.96	0.127	0.180	4.090	0.460
		Second Clip 7/4/2015	24.29	80.57	6.268	18.33	30.79	2.020	4.303	0.020	11.17	0.059	0.157	4.670	0.410
LSD (0.01)			N.S	N.S	N.S	N.S	N.S	N.S	N.S	0.163	N.S	N.S	N.S	N.S	N.S
LSD (0.05)			2.301	N.S	N.S	N.S	N.S	N.S	N.S	0.112	N.S	N.S	0.018	N.S	N.S

N.S: Not Significant

Conclusions

It was concluded from the results of this investigation that most of the quality traits of fenugreek affected significantly by both varieties, nitrogen fertilizer and clipping times:

EP101 variety gave the highest percent of Protein and NDF, but the maximum percent of Digestible Protein obtained by Mite variety, the level of nitrogen fertilizer (40kg N/ha) gave the maximum value of these traits (Fiber, ADF, NDF, ADL, K, and P) % in comparison to no fertilization (N0) which was recorded minimum values of these traits. But concerning Ca and Mg percent, the treatment of control or N0 (No fertilizer application) gave the highest percent, and the first clipping timeout yielded the second clipping time significantly and gave the maximum percent of (Protein, DP, Fiber, and Mg), while the second clipping time exceeded the first clipping time significantly and gave maximum values of (ADF%, NDF%, Lignin%, ADL%, and K%).

In general, the nutrient composition and forage quality legume plants change significantly as the plants developed. Leaves are more digestible with higher protein than stems, so when the plant close to mature, the proportion of leaves are decreased and proportion of stem is increased due to reducing the digestibility and protein of the harvested crop; therefore, the earlier clipping times are recommended to achieve this purpose.

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Appendix 1: Mean squares of variance for forage quality traits:

S.O.V	d.f	Protein%	DP %	Fiber%	ADF %	NDF%	Lignin%	ADL%	Fat %	Ash %	Ca %	Mg %	K %	P %
Block	r-1= 2	7.989	1.386	2.914	2.348	0.902	0.002	0.005	0.000	0.013	0.019	0.001	0.053	0.000
A	a-1= 1	3.168*	0.897*	8.99n.s	0.48 n.s	7.80**	0.15 n.s	0.589n.s	0.007 n.s	0.079n.s	0.000n.s	0.002n.s	0.072n.s	0.000 n.s
Error(a)	(a-1) (r-1) = 2	0.099	0.030	1.775	0.742	0.039	0.310	0.055	0.002	0.034	0.004	0.001	0.022	0.000
B	b-1= 1	2.58 n.s	0.025n.s	26.8**	13.54*	27.5**	0.32 n.s	0.47**	0.028 n.s	0.632n.s	0.22**	0.01**	4.59**	0.004**
A*B	(a-1)(b-1)= 1	0.45 n.s	0.007n.s	0.132n.s	4.305n.s	1.53**	0.48 n.s	0.06**	0.071 n.s	0.243n.s	0.001n.s	0.000n.s	0.023n.s	0.000 n.s
Error(b)	a (b-1) (r-1)= 4	5.598	0.645	0.106	0.675	0.055	0.231	0.001	0.010	0.599	0.004	0.000	0.045	0.000
C	c-1= 1	11.36*	76.7**	7.41**	227.5**	71.0**	13.8**	13.6**	0.014 n.s	1.041n.s	0.001n.s	0.01**	3.69**	0.002 n.s
A*C	(a-1)(c-1)= 1	1.51 n.s	1.47*	18.9**	6.90**	3.565*	0.009 n.s	0.149*	0.006 n.s	0.451n.s	0.000n.s	0.000n.s	0.006n.s	0.000 n.s
B*C	(b-1)(c-1)= 1	104.5**	8.54**	2.64*	0.597n.s	4.59**	0.006n.s	0.18**	0.001 n.s	4.574*	0.05**	0.000n.s	0.586*	0.005**
A*B*C	(a-1)(b-1)(c-1)= 1	11.45*	0.75n.s	2.13 n.s	1.573n.s	0.041n.s	0.820n.s	0.036 n.s	0.054**	0.922 n.s	0.000n.s	0.001*	0.035n.s	0.000 n.s
Error(c)	ab (c-1) (r-1) = 8	1.493	0.235	0.453	0.347	0.347	0.238	0.014	0.004	0.457	0.004	0.000	0.077	0.000
Total	abcr-1= 23													

n.s: not significant

**: significant*