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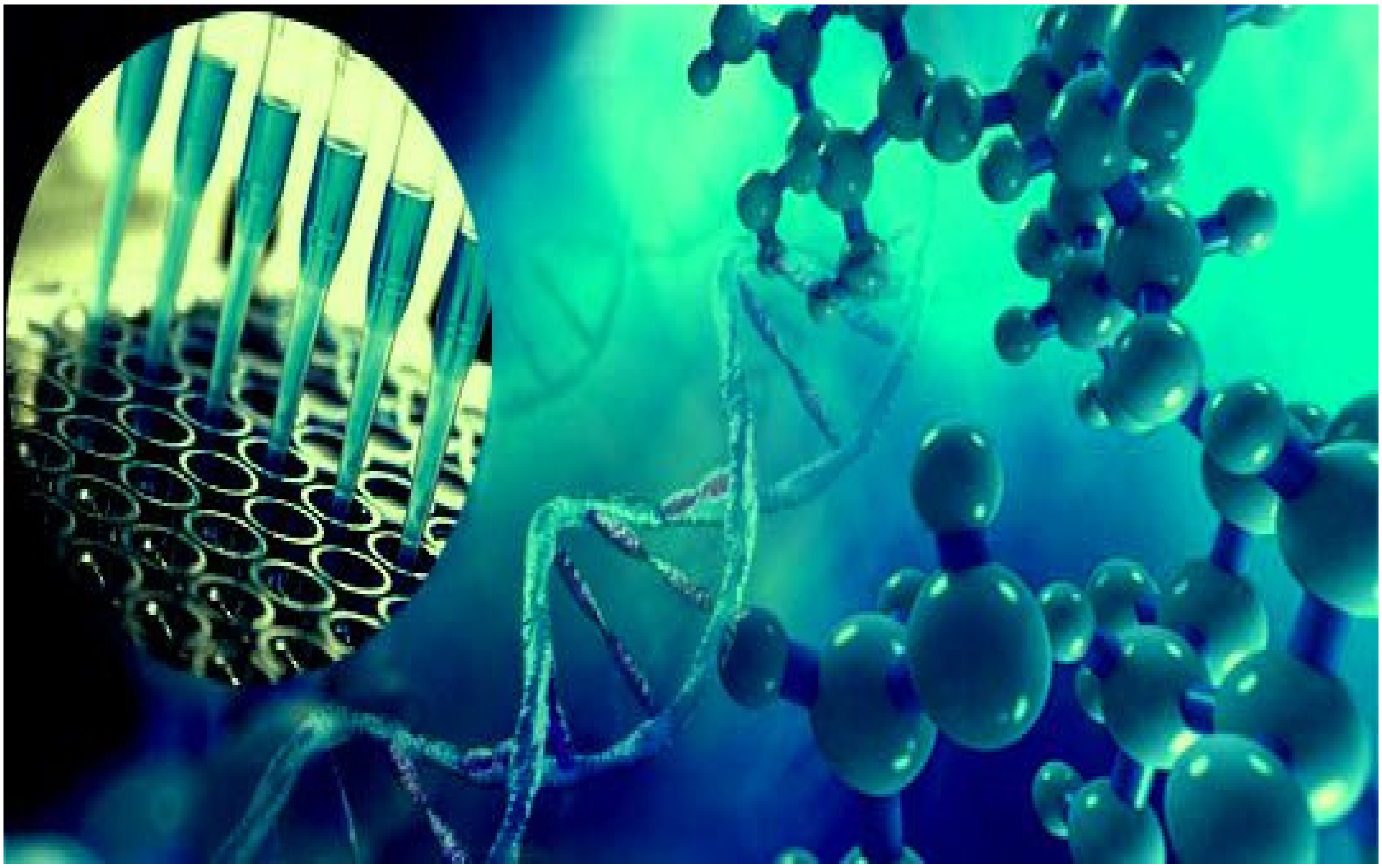

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Evaluation of Quality Characters of Some Egyptian clover Genotypes

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Abstract

The present study was conducted to evaluate the quality characters (Chemical constituents, cell wall contents and nutritive values) of seven promised Egyptian clover (berseem) genotypes comparing with five chick cultivars. A field trial was carried out at Sids research station in (2012/13 and 2013/14) seasons. The twelve genotypes were sown in a randomized complete block design with four replicates. The chemical constituent noted highly significant differences among genotypes in organic matter % which ranged from 85.51% (Gemmiza) to 86.41% (Hatour) with mean average 85.99%. Composite (Narmer + Hatour) genotype recorded the highest content of crude protein (18.91%) whereas Serw-1 had the lowest value (16.06%). Meanwhile Serw-1 recorded the highest non-fiber carbohydrates% (41.62%) followed by Narmer (41.28%) while, Gemmiza recorded the lowest value (39.13%) with mean average 40.21% over all genotypes. The average mean of crude fiber, ash and ether extraction percentages recorded 25.26, 14.00% and 2.80%, respectively.

Wide variation was recorded for the values of cell wall content; acid detergent fiber% values were ranged from 23.09 to 26.12% with mean average of 24.42% across all genotypes. Also, nutrient detergent fiber% ranged from 32.00 to 39.12 % with mean average of 34.53 % and ADL % ranged from 5.11 to 5.72 % with mean average of 5.32% across all genotypes. Moreover highly significant differences were noted in the nutritive value, crude protein yield ranged from 1.47 to 1.84 t fad^{-1} and digestible crude protein% which ranged from 11.40 to 14.05% and also total digestible nutrients % ranged from 68.27 to 71.54% with mean average 69.82%.

Khadarawy and Composite (Narmer+Hatour) had the superior dry yield (9.97 and 9.72 t fad^{-1}). Also, Composite (H+N) recorded the highest crude protein% and crude protein yield (t fad^{-1}), while Gemmiza genotype had the lowest values in dry yield, organic matter%, neutral detergent soluble %, soluble fiber%, digestible dry matter %, dry matter intake %, total digestible nutrients %, relative feed value % and relative forage quality %.

Acid detergent fiber showed significant positive correlation, nutrient detergent fiber and acid detergent fiber, (r = 0.855** and r = 0.760**, respectively), whereas it was correlated significantly and negatively with neutral detergent soluble, soluble fiber, total digestible nutrients, relative feed value and relative forage quality %. Nutrient detergent fiber was a significantly and negatively correlated with all the other contents except acid detergent fiber% which showed significant positive relation (r = 0.721**). Hatour and Narmer genotypes performed the higher percentages of total digestible nutrients % across all studied genotypes.

Key words: Berseem, Egyptian clover, chemical constituent, cell wall content and nutritive value, correlation.

I. INTRODUCTION

Egyptian clover, berseem, (*Trifolium alexandrinum* L.) is an erect and native cool-season annual legume in the Mediterranean region (Knight, 1985). The crop is believed to be indigenous to Egypt. It is the main forage legume and it forms the principal green forage for animal feed. It is widely grown for fodder and green manure.

Quality and digestibility of dry forage is affected by stage of maturity, which is reflected on its nutritive values. The cutting height is a very important parameter which influenced plant yield, quality of the harvested forage and plant regeneration speed and sustainability of culture (Chen *et al.*, 2012 and Onyeonagu and Ugwuanyi, 2012).

Abdel Gawad (2003) studied forage quality of different berseem cultivars and accessions and convinced that local cultivars had best quality than accessions. The later cuts of berseem had higher values when calculated as feed; it is poorer in digestible protein than earlier cuts on dry matter (DM) basis (Saleh, 1986). Egyptian clover contains high concentrations of digestible dry matter (DDM) and crude protein (CP) (Hattab and Harb, 1994). Chauhan *et al*. (1980) found that the DM and crude fiber (CF) contents of berseem were increased with the progress of cut, but CP content (on DM basis) was decreased. Information on the nutritive value of berseem for ruminants is limited. The CP concentration of berseem was also consistent with a range of 180-270 g kg^{-1} DM (Duke *et al*., 1981) and also from 180 to 300 g kg^{-1} DM (Guessous *et al.,* 1981). Cell wall constituents analysed as fibre insoluble in a neutral detergent solution (NDF), were shown to consist of cellulose, hemicellulose, and lignin, with lignin and cellulose being combined in acid detergent fiber (ADF). Thus, NDF is an estimate of total cell-wall concentration for forages and results the fraction best correlated to digestibility (Goering and Van Soest, 1970).

The forage legume germplasm selection programs in Egypt, gave more attention, to environmental adaptation, herbage DM, yield potential and seed bearing ability of candidate accessions, while data on their nutritive value is generally scarce. This suggests the need for more research work focusing on characterization of the herbage nutritional quality of elite forage genotypes and their potential in livestock feeding to be effectively exploited.

Therefore, the objectives of the present study were to; identify best performing berseem genotypes through assessing their herbage dry matter yield potential, nutritive value and to examine the association between feeding value and plant cell-wall components.

II. MATERIALS AND METHODS

The present study was carried out in two growing seasons (2012/13 and 2013/14). The matterials used in this study were twelve Egyptian clover genotypes; five registered cultivars, Sakha-4, Helaly, Gemmeiza-1, Giza-6 and Serw-1 as well as seven new promising genotypes, Hatour, Narmer, New Khadarawy, Big floret, Composite of New (Narmer and Hatour), New Narmer and New Hatour developed by (Abd El-Naby, 2003, Abd El-Naby, 2009 and Abdalla and Abd El-Naby, 2013) as described in Table (1).

Table 1. Names and origin of the studied genotypes.

No.	Genotypes	Pedigree
1	Narmer	Produced from Synthetic-79 pop. by selection for high self-fertility without rolling for four years
2	New Narmer (N)	Developed by continuous selection of high self fertility with high yielding till 2007
3	Hatour	Produced from Ahaly pop. by selection for high self-fertility without rolling for four years
4	New Hatour (H)	Developed by continuous selection of high self fertility with high yielding till 2007
5	Composite (H+N)	Mix of New Narmer and New Hatour genotypes
6	Khadarawy	Selection for high yield and long duration from Hatour genotypes
7	Big floret	Developed by selection for big size of florets and high yield
8	Sakha-4	
9	Helaly	
10	Giza-6	Commercial cultivars
11	Serw-1	
12	Gemmiza	

Field procedures:

The present study was conducted at the experimental farm of Sids Research Station (Middle Egypt), ARC, during two successive seasons (2012/13 and 2013/14). The recommended cultural practices developed by Forage Crops Research Sec, Field Crops Res. Inst., ARC, for the old land had been followed regarding soil preparation, NPK fertilization, irrigation and harvesting management in the two seasons. The experiments were sown on October 15*th* and 18*th* in the first and the second seasons, respectively. Seeds were drilled in plots 2 X 3 m (1/700 fad.) during the two seasons. Seeds of each genotype with seeding rate of 20 kg/fad (30 g $plot^{-1}$) were equally distributed within each plot. The twelve genotypes were randomly sown in a randomized complete block design with four replicates.

Five cuts were harvested, the first was 55 days after planting and the following cuts were taken 30 days intervals. Cutting treatment was applied from the sixth internode elongation of the main shoot (De Santis *et al.,* 2007).

Forage Evaluation:

a- Chemical constituent

Cutting was conducted using a hand sickle mower. Because berseem genotypes are differing in their post-harvest re-growth, plants were cut from 6-8 cm above ground surface. For preventing humidity loss, fresh forage was weighed immediately after cut using a portable balance. To determine forage dry weight a 200 g fresh forage sample was dried from each plot under room temperature without direct exposure of sunshine. After several days when samples showed consistent weight during three subsequent days, the obtained weight was considered the dry weight. Percentage of dry matter production (% DM) of each cut was calculated. 150 g sample of pooled dry matter over all cuts, 30 g per cut per genotype, was analyzed for quality characters. The percentages of crude fiber (CF), crude ash and ether extract (EE) were determined according to the A.O.A.C. procedures (2005).The (CP) content was calculated from the N content (CP = N × 6.25), (Bozkurt and Kaya, 2010). Nitrogen free extract (NFE%) and organic matter (OM%) were estimated by using the following equations: NFE% = 100 – (CP% + CF% + EE% + Ash%) and OM% =100 – (Ash%).

b- Cell wall content

Acid detergent fiber (ADF), nutrient detergent fiber (NDF) and acid detergent lignin (ADL) were determined using the ANKOM filter bag technique (Komarek, 1993). Cellulose and hemi-cellulose concentrations were estimated according to these equations: (1) NDF = Hemi-cellulose + Cellulose + Lignin + Ash and (2) ADF = Cellulose + Lignin + Ash.

c- Nutritive values

Digestible dry matter (DDM%), dry matter intake (DMI%), neutral detergent soluble % (NDS) and soluble fiber were estimated according to Aydın *et al*. (2010), relative feeding value % (RFV) was estimated according to Uttam *et al*. (2010) and relative forage quality % (RFQ) was estimated according to (Moore and Undersander, 2002).

Data Analysis

Data were statistically analyzed by SAS 9.1 (2004). Data from the 2013 and 2014 growing seasons are presented in a combined analysis, because the test of homogeneity of variance (Winer 1971), performed insignificantly differences. Factor analysis basically reduces large number of correlated characters to small number of uncorrelated factors. The mathematical technique was described by (Jardine *et al.,* 1963 and Cattell, 1965). The factor loading of rotated matrix, percentage of variability and communalities for each variable were determined.

III. RESULTS AND DISCUSSION

a-Chemical constituent

Combined means of chemical components of dry matter of tested genotypes over the three seasons are presented in Table (2). The percentages of organic matter (OM%), crude protein % (CP), nitrogen free extract% (NFE), ether extraction (EE) and ash recorded significant differences ($P \leq 0.05$) across all genotypes, whereas crude fiber (CF) showed insignificant differences. OM% ranged from 85.51 to 86.41%. Genotypes 5, 2 and 8 had the highest content of CP with 18.91%, 18.74% and 18.54 %, respectively, whereas genotypes 11 had the lowest value (16.06%). NFE % ranged from 39.13% for genotype-11 to 39.13% for genotype (12). The average means of ash and ether extraction percentages recorded 14.00% and 2.80%, respectively (Table 2). These results agreed with those reported by Abd El-Halim *et al.* (1993), Putnam *et al.* (2001) and Abdel Gawad (2003).

Table 2. Combined means of chemical composition of dry matter of twelve berseem genotypes over five cuts.

Genotypes		Mean% ±SE					
		OM	CP	NFE	CF	Ash	E.E.
Elite genotypes	1	86.03±0.01	17.51± 0.01	41.28±0.73	24.53± 0.70	13.97± 0.01	2.71± 0.57
	2	86.02±0.23	18.74±0.51	39.34 ±0.81	25.22± 0.91	13.98 ±0.23	2.71± 0.17
	3	86.41±0.28	17.55 ±0.05	41.07±0.77	25.23± 0.79	13.59 ±0.28	2.65± 0.20
	4	86.06±0.08	18.16 ±0.22	40.20±0.66	25.06± 0.85	13.94± 0.08	2.64± 0.09
	5	86.34±0.02	18.91± 0.34	39.09±0.97	25.14± 1.35	13.66 ±0.02	3.20± 0.05
	6	86.34±0.09	17.47±0.02	40.33 ±0.38	25.54± 0.47	13.66 ±0.09	3.00± 0.02
	7	86.18±0.11	17.65±0.15	41.00 ±1.57	24.80 ±1.36	13.82 ±0.11	2.72± 0.02
Chick genotypes	8	85.77±0.18	18.54±0.71	39.81±0.66	25.19 ±1.06	14.23± 0.18	3.23 ± 0.13
	9	85.51±0.06	18.03±0.35	39.67±0.81	24.95± 0.93	14.48 ± 0.06	2.87± 0.16
	10	86.07 ±0.10	16.44 ±0.53	41.05±1.67	25.98 ±1.24	13.93±0.100	2.60± 0.05
	11	85.74±0.29	16.06±0.31	41.62±1.19	25.42 ±1.10	14.26± 0.29	2.64± 0.05
	12	85.51± 0.27	17.34 ±0.16	39.13±0.91	26.05± 0.67	14.49± 0.27	2.99± 0.05
Mean		**85.99**	**17.70**	**40.21**	**25.26**	**14.00**	**2.82**
L.S.D. (0.05)		**0.5297**	**1.0130**	**1.5799**	**n.s.**	**0.5297**	**0.3024**

SE= Standard error.

b- Cell wall content

Significant differences were recorded among genotypes for acid detergent fiber % (ADF), nutrient detergent fiber % (NDF), acid detergent lignin (ADL) concentrations, nutrient detergent soluble %(NDS) and soluble fiber% recorded (Table 3). Acid detergent fiber % (ADF) values varied from 23.09 to 26.12%. The promising genotypes had lower ADF content than the chick cultivars. NDF concentration ranged from 32.00 % for genotype 3 to 39.12 % for genotype 12. Acid detergent Lignin % (ADL) varied from 5.11% (genotype 4) to 5.72% (genotype 12) with an average of 5.32% across all genotypes.

Declines in digestibility in forage have been linked to factors such as dry matter properties (Brink and Fairbrother, 1992). Kazemi *et al.* (2012) and Ball *et al.* (1997) reported high content of ADF<31% and NDF<40 % of alfalfa (*Medicago sativa*) cultivars, also Markovic *et al.* (2007) found that the ADL content of the alfalfa cultivars ranged from 5.24 – 5.97 %.

Table 3. Fiber fractionation values of twelve berseem genotypes.

Genotypes		Nutrient values %						
		ADF	NDF	Cellulose	Hemi cellulose	ADL	NDS	Soluble fiber
Promised genotypes	1	23.09l	32.85j	4.00l	9.76g	5.12k	53.18h	5.65f
	2	24.11h	33.54f	4.90h	9.43h	5.23j	52.48e	5.67e
	3	23.17k	32.00l	4.21k	8.83j	5.37f	54.41a	6.82a
	4	23.80j	33.15h	4.75i	9.35i	5.11l	52.11f	5.85c
	5	24.25g	32.32k	5.24e	7.97l	5.35g	54.02b	6.58b
	6	23.93i	33.51g	5.00g	9.57f	5.27i	52.84d	5.69d
	7	24.36e	33.09i	5.17f	8.73k	5.37e	53.09c	5.53g
Chick genotypes	8	24.28f	34.13e	4.61j	9.85e	5.44d	51.64g	5.29h
	9	26.12a	36.86c	6.01a	10.74d	5.63b	48.66j	2.58ji
	10	24.92d	37.40b	5.45c	12.48b	5.54c	48.67j	2.51k
	11	25.38c	36.38d	5.79b	11.00c	5.33h	49.36i	3.30i
	12	25.62b	39.12a	5.41d	13.50a	5.72a	46.39k	1.42l
Mean		**24.42**	**34.53**	**5.04**	**10.11**	**5.32**	**51.47**	**4.74**

Means in each column followed by similar letters are not significantly different at 5% level.

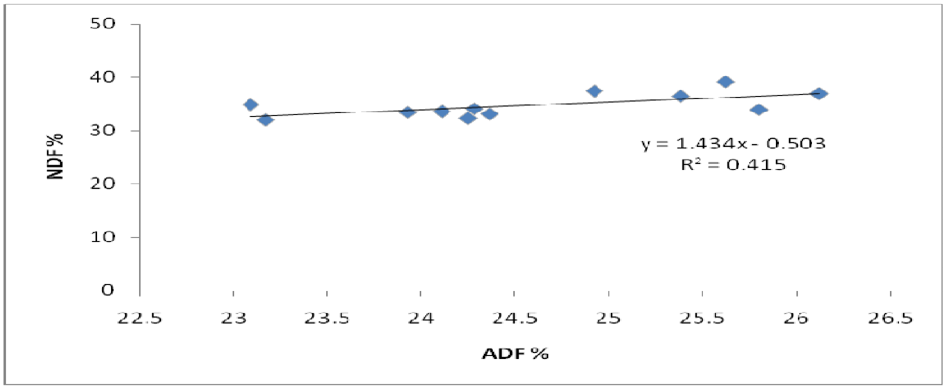


Figure 1. Linear relationship between ADF% and NDF% in berseem dry forage yield.

Figure (1) shows that the increases in ADF content of Egyptian clover forage dry matter associated with changes in other nutrients. The most obvious change is that as the ADF level increase, so does the NDF level. NDF captures all of the structural fiber (unlike ADF that only captures from 20 to 40% of it in berseem dry yield) and since NDF is the fastest digesting portion of the plant that is in fact digestible, its increase will reduce the energy level of the dry yield. Figure (1) explains this relationship of berseem dry matter analyzed.

Albayrak *et al.* (2011) reported that the ADF concentration refers to the cell wall portions of the forage. These portions consist of cellulose and lignin. The ADF values are important because they describe the ability of an animal to digest the forage. As the ADF increases, the digestibility of the forage usually decreases. The NDF value refers to the cell wall content, composed of the ADF fraction plus hemicelluloses. Neutral detergent fiber values are important in ration formulation because they reflect the amount of forage that the animal can consume. As the NDF percentages increase, the dry matter intake will generally decrease (Joachim and Jung, 1997).

Figure (2) and Table (3) show the cell wall contents of cellulose, hemi-cellulose and lignin of the twelve berseem genotypes. Narrow variation among genotypes in cellulose and lignin percentages was existed. Genotype 9 had the highest percentage of cellulose across all genotypes (6.01%) and Genotype 12 had the highest content of hemi-cellulose (13.5%).

Check genotypes had higher values varied from 9.85 to 13.50%, while the promised genotypes recorded medium values varied from 7.97 to 9.76% (Fig. 2).

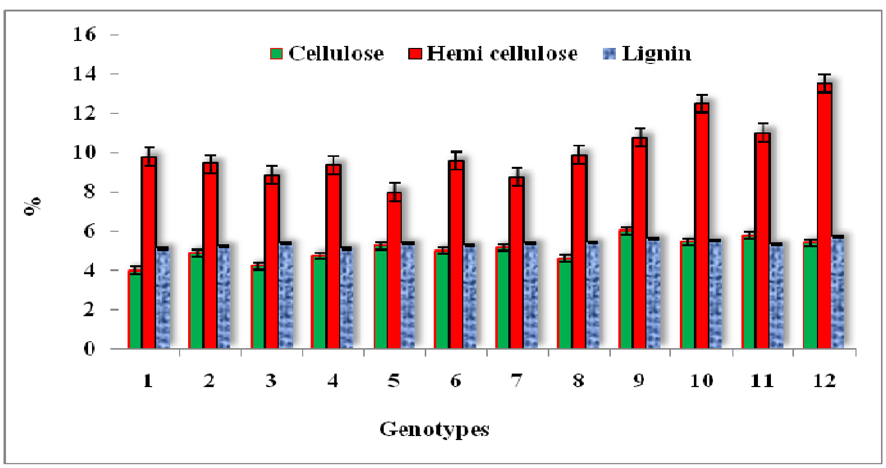


Figure 2. Cellulose, Hemi-cellulose and lignin content ± SE of twelve berseem genotypes. (SE= standard error)

c- Nutritive values

The nutritive values of dry matter yield t fad^{-1} (DMY), dry matter digestibility (DDM%), dry matter intake (DMI%), crude protein yield (CPY t fad^{-1}) and digestible crude protein% (DCP) on dry matter basis indicated highly significant differences among all genotypes (Table 4).

Moreover, the digestibility coefficient means of dry yield t fad^{-1}, dry matter digestibility (DDM %), dry matter intake (DMI %), crude protein yield (CPY t fad^{-1}) and digestible crude protein% (DCP) were 9.45%, 65.57%, 3.46%, 1.67 t fad^{-1} and 12.92 %, respectively. Genotypes 6 and 5 had the highest dry matter yield (9.97 and 9.72 t fad^{-1}), while genotype 12 had the lowest dry matter yield across all genotypes (9.08 t fad^{-1}).

Dry matter digestibility (DDM%), dry matter intake (DMI %), percentages tended to be higher in genotype 3 with (67.86% and 3.75%, respectively, whereas genotype 12 had the lowest value. Genotype 5 had the highest values of CPY (t fad^{-1}) and digestible crude protein% (DCP) across all genotypes (1.84 t fad^{-1} and 14.05%) followed by genotype 2 (1.78 t fad^{-1} and 13.89). Phillip (1996) reported that nutritive values of berseem dry yield as a sole feed for sheep was 56.52% TDN and 9.88% DCP. Little differences were obtained across all genotypes for DMI%, which ranged from 3.75% to 3.07% with an overall average of 3.46%. The promised genotypes showed similar performance as they had higher percentages of (TDN %) ranged from 69.90 to 71.54%. The check cultivars recorded similar performances with low TDN values ranged from 67.63% for genotype 9 to 70.0% for genotype 8. Relative forage value (RFV %) had best performance over all genotypes with super values of promised genotypes ranged from (177.33 % to 197.26%), whereas check genotypes had values ranged from 149.88 % to180.39% (Table 4).

For the relative forage quality (RFQ%), promised genotypes performed the best percentages across all genotypes and ranged from 200.28 to 217.80%, while check genotypes recorded good performances with a range of 170.27 to 200.11 % (Table 4).

Table 4. Average of dry matter yield (DMY) t fad^{-1}, dry matter digestibility (DDM%), dry matter intake (DMI %), crude protein yield (CPY t fad^{-1}), digestible crude protein%, total digestive nutrients (TDN%), and relative feeding value (RFV%) and relative forage quality (RFQ%) .

Genotypes		Forage quality traits (% DM)							
		DMY t/fad	DDM%	DMI%	CPY t/fad	DCP%	TDN%	RFV%	RFQ%
Promised genotypes	1	9.41g	66.43c	3.44g	1.65g	12.75h	71.54a	177.33h	200.28h
	2	9.48bd	66.07g	3.58d	1.78b	13.89b	70.22d	183.24f	204.27f
	3	9.42f	67.86a	3.75a	1.65g	12.78g	71.44b	197.26a	217.80a
	4	9.43e	65.46h	3.53e	1.71d	13.35d	70.62c	183.69d	207.85c
	5	9.72b	66.99b	3.71b	1.84a	14.05a	70.04e	192.80c	211.43b
	6	9.97a	66.11f	3.58d	1.74c	12.72i	70.46d	183.56e	205.19e
	7	9.53c	66.39d	3.63c	1.68f	12.88f	69.90g	186.63b	206.09d
Chick genotypes	8	9.39h	66.18e	3.52f	1.74c	13.70c	70.00f	180.39g	200.11g
	9	9.43e	63.90e	3.26i	1.70e	13.23e	67.63l	161.27j	179.00j
	10	9.41g	64.77i	3.21j	1.55j	11.75k	69.18h	161.09k	180.46k
	11	9.17i	63.71j	3.30h	1.47k	11.40l	68.58i	162.92i	183.92i
	12	9.08j	63.03k	3.07k	1.57h	12.59j	68.27j	149.88l	170.27l
Mean		**9.45**	**65.57**	**3.46**	**1.67**	**12.92**	**69.82**	**177.57**	**198.24**

Means in each column followed by similar letters are not significantly different at 5% level.

The RFV% is an index that is used to predict the intake and energy value of forage. This index is derived from the DDM% and dry matter intake (DMI%). All genotypes recorded RFV % higher than 151%, and considered as a prim genotypes according to Uzun (2010) category. The relative feeding value is not a direct measure of the nutritional content of forage, but it is important for estimating the value of forage (Van Soest, 1982).All studied genotypes had a prime performance of RFV% as a superior intake% and the energy value of their forage yield ranged from 161.09% for check genotype-10 to 197.26 % for promised genotype-3, whereas check genotype -12 noted (149.88%) premium prediction of RFV with overall averaged of 177.57%.

The correlation coefficients between the percentage of ADF, NDF, ADL, CP, CPY, DCP, TDN, RFV and DMY are given in Table (5). CP% had high significant and positive correlation with CPY t fad^{-1}and DCP% (0.933** and 0.998**), significant negative correlation with NDF (-0.516) and insignificant positive correlation with DMY t fad^{-1} (0.384), whereas it correlated negatively with ADF and ADL% (-0.279 and -0.193, respectively). DCP% had high significant and positive correlation with DMY t fad^{-1} (0.690**) and negative correlation with CPY (0.933**).

ADF% showed high significant and positive correlation with NDF and ADL% (-0.855** and 0.721**), while ADL% recorded negative high significant correlation with TDN% (-0.721) and negative significant correlation with RFV% (-0.654). It means that increasing in ADF% content decreased CP%, CPY t fad^{-1}, DCP%, TDN%, RFV% and DMY t fad^{-1} contents and also decreased the forage quality. NDF had a high significant and negative correlation with TDN% and RFV% (-0.721**, -0.992**, respectively).

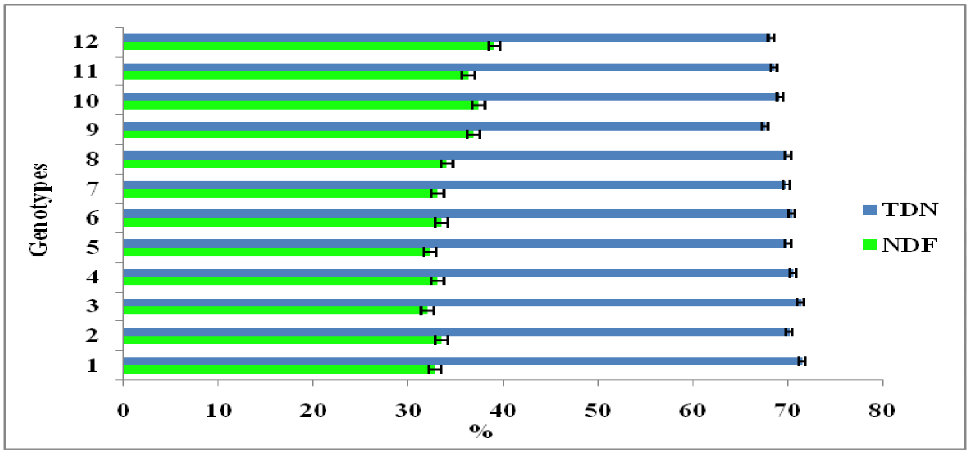
Table 5. Correlation coefficients between percentages of ADF, NDF, ADL, CP, CPY, DCP, RFV and DMY.

	CP%	CPY	DCP%	ADF%	NDF%	ADL%	TDN%	RFV%	DMY t fad-1
CP%	**1**								
CPY	**0.933****	**1**							
DCP%	**0.998****	**0.933****	**1**						
ADF%	**-0.279**	**-0.376**	**-0.279**	**1**					
NDF%	**-0.516***	**-0.637***	**-0.516***	**0.855****	**1**				
ADL%	**-0.193**	**-0.28**	**-0.193**	**0.721****	**0.717****	**1**			
TDN%	**0.279**	**0.376**	**0.279**	**-0.998****	**-0.855****	**-0.721****	**1**		
RFV%	**0.513***	**0.632***	**0.513***	**-0.874****	**-0.992****	**-0.654***	**0.874****	**1**	
DMY t fad-1	**0.384**	**0.690***	**0.384**	**-0.413****	**-0.597***	**-0.332**	**0.413**	**0.591***	**1**

*,** significant and high significant differences at 0.05 and 0.01 levels of probability, respectively**.**

TDN% showed highly significant and negative correlations with ADF, NDF and ADL% (-0.998**, -0.855** and -0.721**, respectively), TDN% had insignificant positive correlation with DMY t fad^{-1}, CP, CPY and DCP%. Data showed insignificant correlation between RFV% with CP% and DCP% (0.279 and 0.376), significant positive correlation with DMY t fad^{-1} and CPY (0.591* and 0.690*), significant negative of (0.654*), significant positive correlation with TDN (0.874**) and significant negative correlation with ADF and NDF % (-0.874** and -0.992**, respectively).

Figure (3) showed the mean values of NDF% and TDN% among the twelve genotypes of berseem. Genotypes 3 and 5 had the lowest mean values of NDF%, whereas genotypes 1 and 3 had the highest percentages of TDN%. Concerning the NDF% genotype 12 had the highest mean value across all genotypes followed by genotypes 10 and 9, respectively. Genotype 8 performed the highest mean value of TDN across the five check genotypes (Table 4 and Figure 3).



:Figure 3. Relationship between genotypes, NDF% and TDN% ±SE.
SE: Standard error

Factor analysis

Factor analysis complemented on the basis of special values which are larger than one and was done by considering three factors that affected by DMY t fad^{-1} (Table 6). These three factors justified (97.30%) of corresponding data variation, as a whole. Traits placed which on the subdivision of a factor with similar sign, all of them were influenced by an unknown nature in similar direction. Each factor has no individual existence, but it is resultant of processes and characteristics which were influenced by those traits. The factors justified (chemical constituents, cell wall content% and nutritive value) changes among genotypes (Table 6). Also, factor analysis grouping and characters of twelve genotypes under three main factors and accented the communality of each variable and its total communality h^2 for all factors. The highest values of total communality h^2 scored by ADL% (x5= 0.998) followed by CP% and DCP% (x2=X3=0.995) (Table 6). Both TDN% and ADF% recorded the same h^2 (x6=x3 =0.961) with dissimilarity signs of factorial values. The presented results indicated that ADF% followed by RFV% were the most effective characters because of their higher communality across all traits. ADL% decreased the forage quality and nutritive values, and then selection for high RFV% increased the feeding values of improved genotypes.

Table 6. Loading and variance ratio of three factors grouped from studied characters of twelve Egyptian clover genotypes compared with total variance ratio using factor analysis.

Variables	Loading	Communality (h^2)	Cumulative variance %	Latent root
Factor 1			52.30	3.33
ADF% x3	-0.939	0.961		
NDF% x4	-0.845	0.939		
TDN% x6	0.939	0.961		
RFV% x7	0.888	0.957		
Factor 2			31.80	2.22
CP% x1	0.981	0.995		
DCP% x2	0.981	0.995		
Factor 3			13.20	0.92
ADL% x5	-0.851	0.998		
Cumulative variance %			97.30	6.81

Sharing of each factor in DMY t fad^{-1} from the first to third is 52.30, 31.80 and 13.20, respectively. Factor analysis showed that the third factor has large and negative factorial for traits like ADL% (x5) (-0.851) decreasing forage quality (Table 6).

Second factor can be called effective quality performance. The third factor has a large and negative coefficient for trait ADL% (x5), it can be pointed to negligible forage quality. The first factor included four characters, two with positive CP% (x1) and DCP% (x2) that can predict yield quality.

The factor analysis has provided by grouping variables into three main factors. The findings of this study may help both of biologists and breeders in determining characters which could be selected for giving high forage quality that can be used to improve Egyptian clover for yield and quality. **Singh *et al.* (2007)** used factorial analysis to evaluate forage and seed yield in berseem clover germplasm.

IV. Conclusion

It could be recommended that, forage breeders should be focused on these traits of berseem in breeding program for high quality.

The results of this study were concluded that:

- Chemical constituent, cell wall contents and nutritive value can provide a reliable predictor of genotypes evaluation.
- Studied genotypes were significant differences in nutritive value. Khadarawy genotype was the highest genotype in dry forage yield.
- Composite (Narmer + Hatour) recorded the highest value of crude protein and digestible crude protein%.
- Hatour and Narmer genotypes performed the highest values of total digestive nutrients because their lower contents of ADF, NDF, cellulose, ADL, NDS and soluble fiber across all studied genotypes.
- New Hatour genotype had the lowest content of ADL% comparing with the other studied genotypes.
- RFV% and DCP% were high positive effect of DMY t fad^{-1}, whereas ADF% correlated high negative effects.
- Promising genotypes are eligible for certification according to their higher performances in yield and quality.

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